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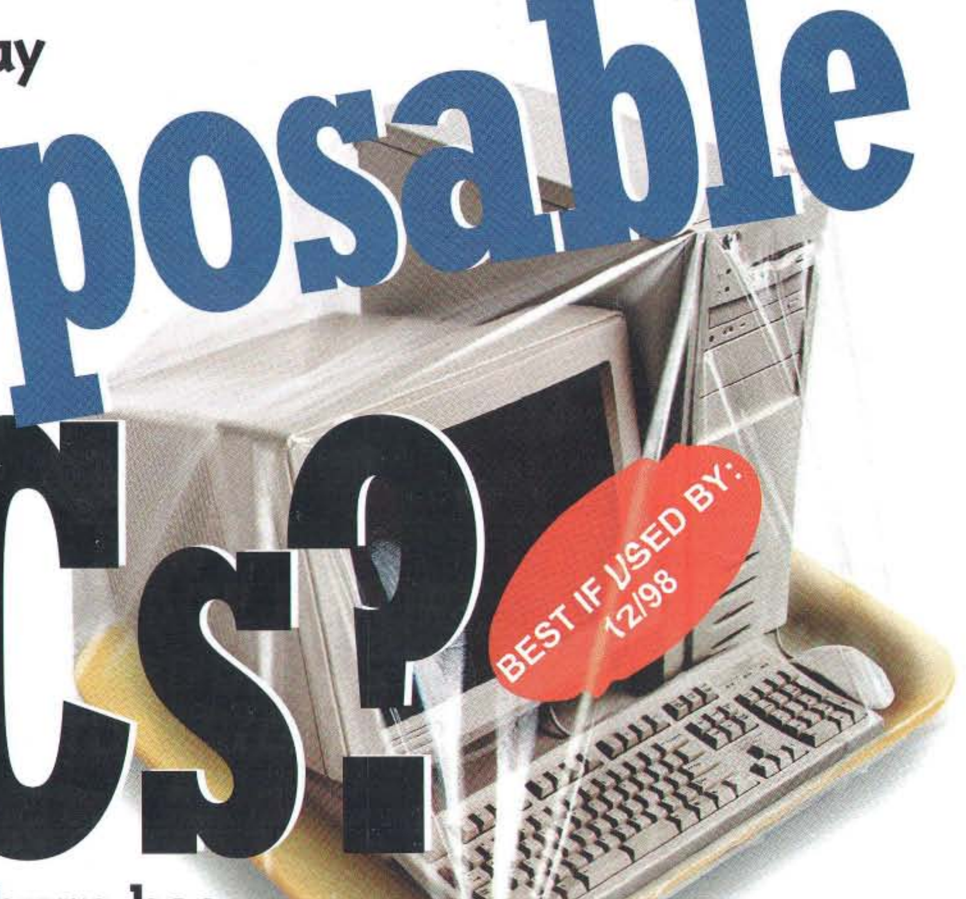
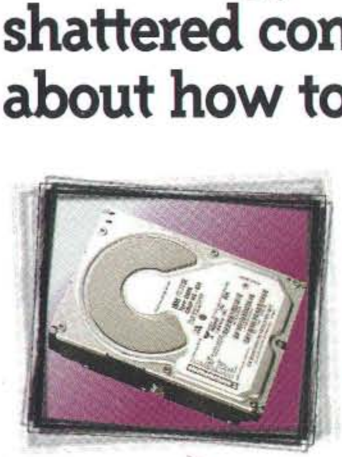
Should You Buy disposable PCs?



Technology churn has shattered conventional wisdom about how to buy PCs



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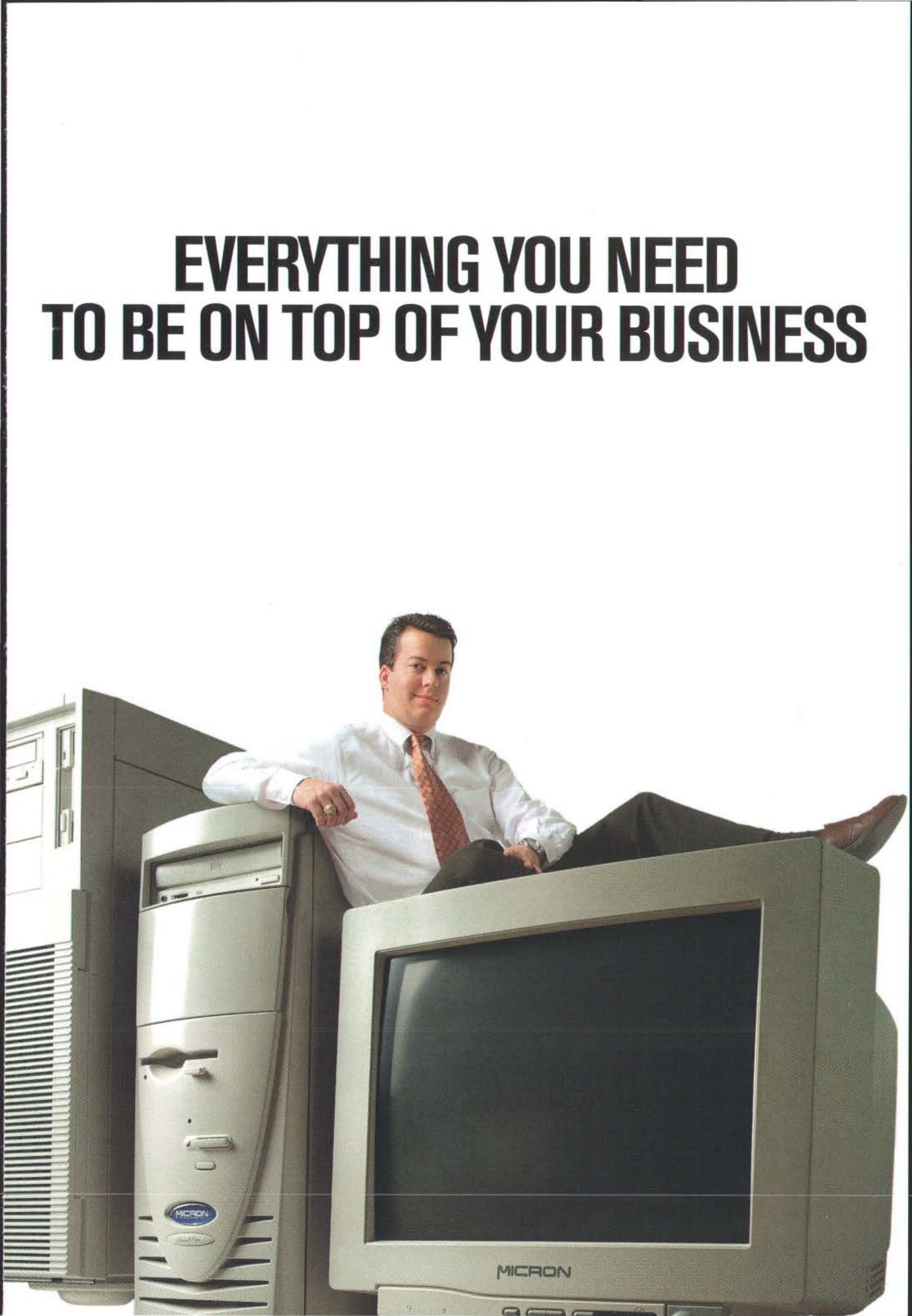
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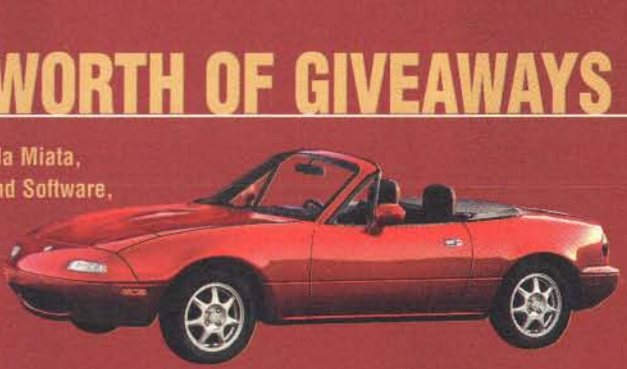

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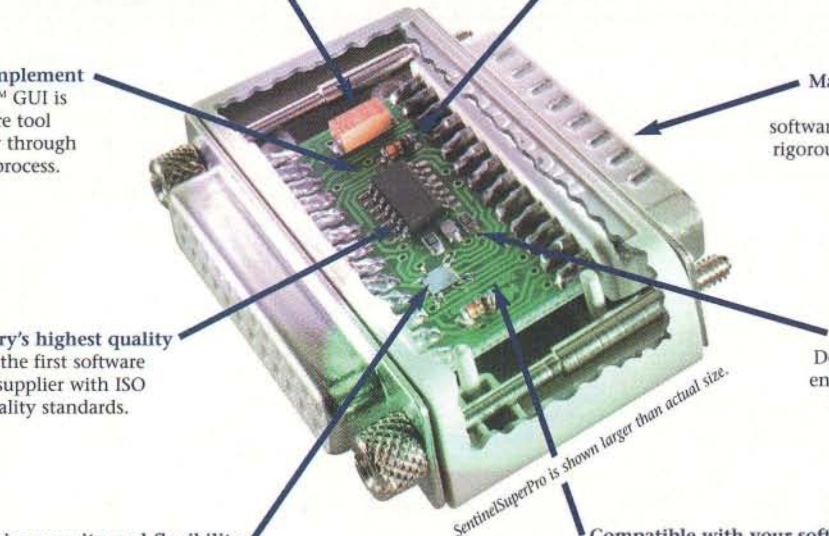

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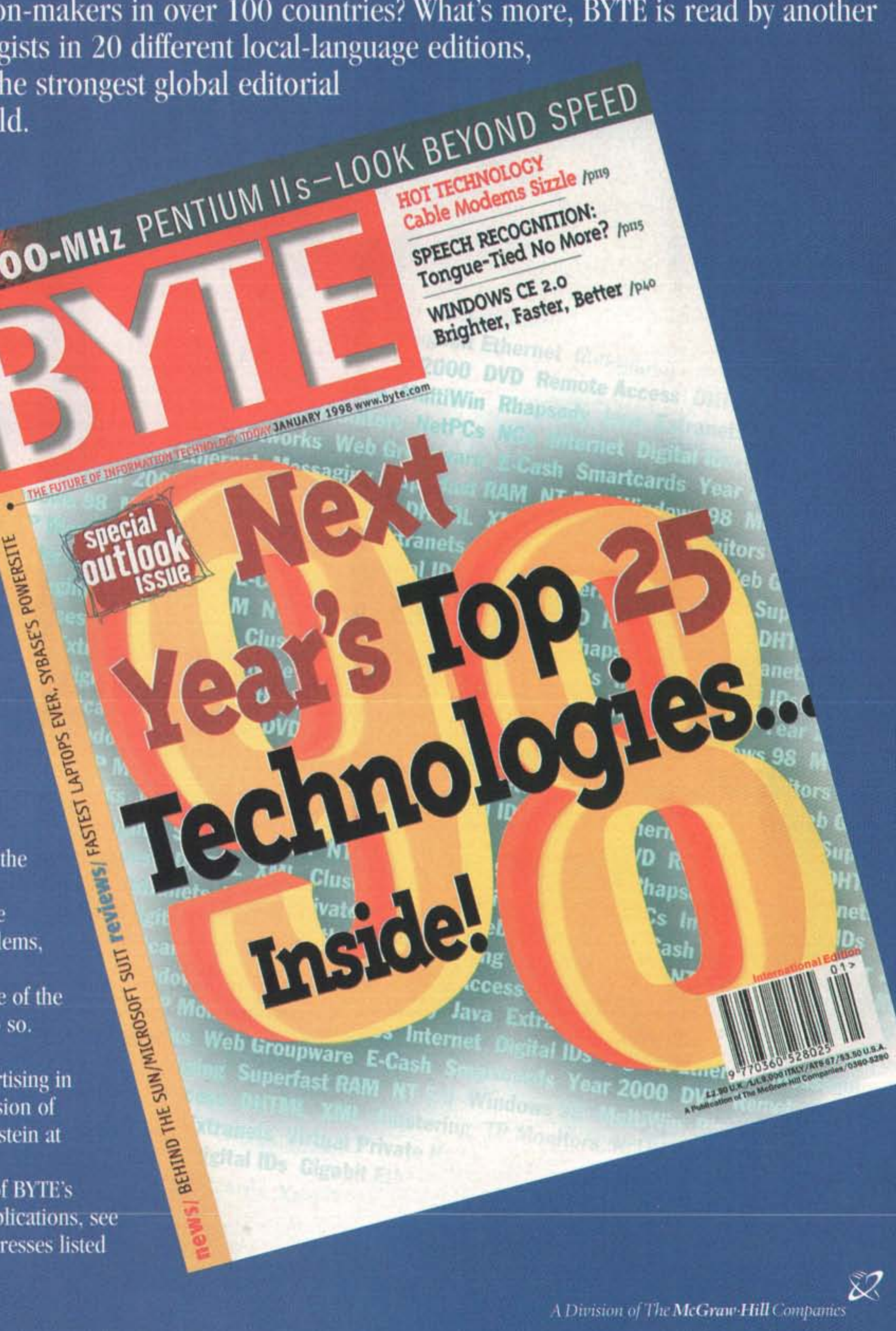
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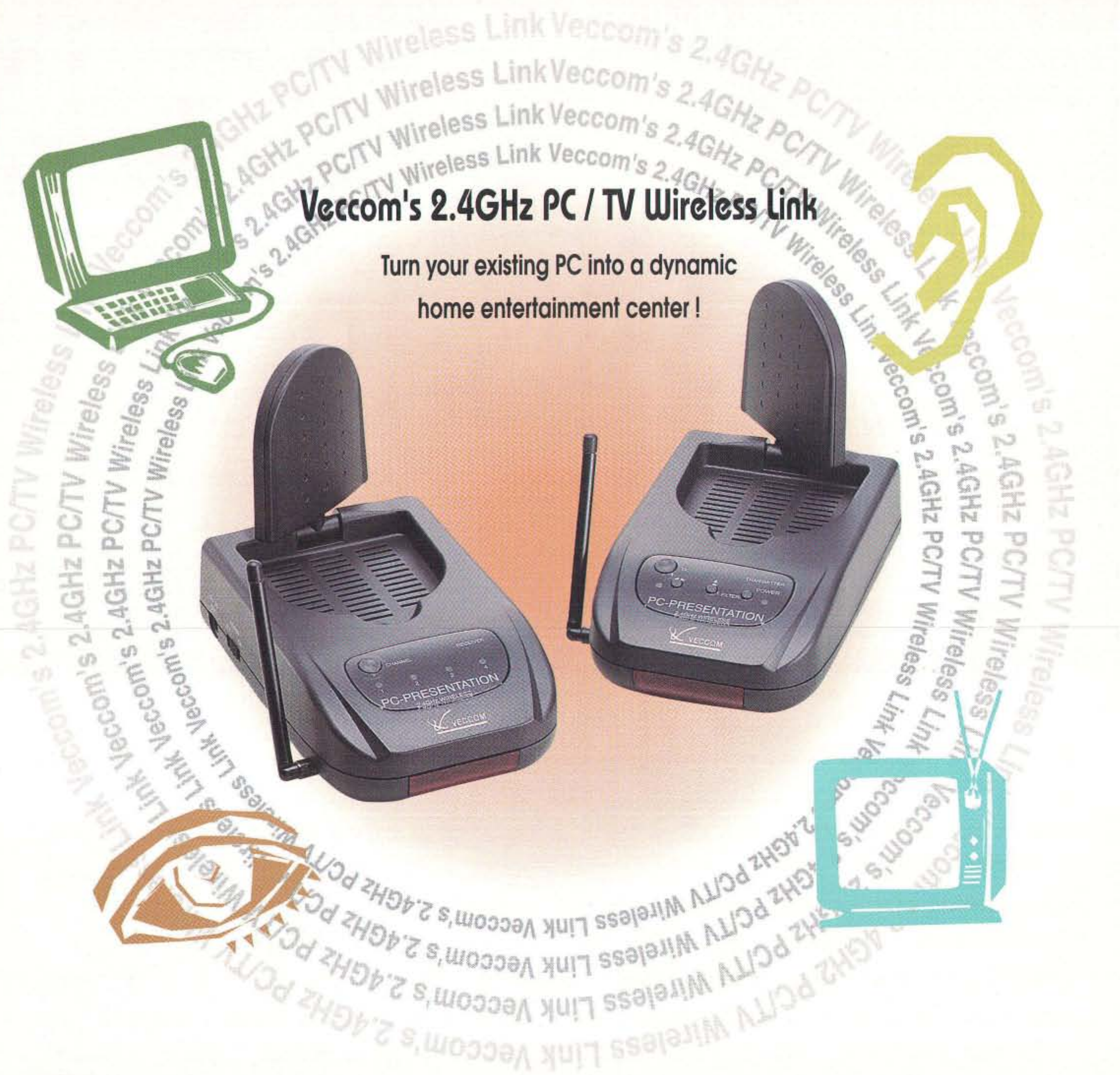

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editorial

Coping with Change

The pace of change has shattered old PC buying models.

Moore's Law has finally pushed the pace of PC hardware development through the sound barrier. A product manager for one of the Big Three PC companies recently pointed to one of his latest systems and told me, "In 12 months, everything in this machine will be different." And he meant *everything:* processor, memory, video, bus speed, network card, disk drive interface, and high-volume storage modes.

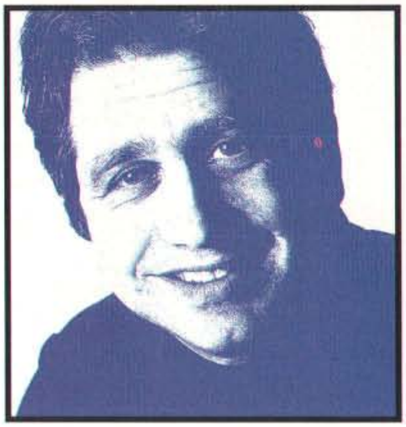
"Where've you been?" I hear some of you saying. "It's always been this way." To a degree, yes, but I'd submit that the increasing quantity of change has finally turned into a different *quality* of change. While everything in the aforementioned computer will be different in 12 months, the changes will happen continually, not just annually. What ever happened to the idea of a computer design you could settle on for a year?

Intel, which is driving much of this change, concedes that many new technology developments are pushed forward by intra-industry competition, not customer demand. But it's not all technology for technology's sake—if you're a smart shopper, you can increasingly find just what you need among all the variants of PC technology. Buy that financial analyst a $3500 dual-processor system if she needs it, but don't shrink from spending a mere $999 on a system for the receptionist to get his e-mail. Got a dog of a Web server? Faster multiprocessor hardware's cheap compared to losing customers.

Nonetheless, Intel's attitude has a certain run-it-up-the-flagpole-and-wait-until-they-salute quality. Witness universal serial bus (USB) and MMX, two technologies that have waited long for third-party support. When one-third of your three-year life cycle is spent waiting for the very thing you bought a system for, can the words "investment protection" have any meaning? After all, if you'd waited those 12 months, last year's $2400 200-MHz Pentium MMX would have cost you $1200. So before you buy a new technology, ask yourself if it's really compelling.

Compelling, to me, means at least the following:

- A technology must have an impact on the specific needs of users. Now that we're hitting 300-MHz clock speeds, for example, raw power alone is unlikely to be compelling for mainstream business users. Unless office suites go on another binge, users have clock cycles to burn. But if you're planning to implement voice recognition within a year, then horsepower is critical. In the end, is there a business case for the latest PC technology?
- A technology must be compelling in that it will change, within a reasonable time frame, the way you do computing. Power management was such a change for notebooks; the various management features built in to PC98 motherboards will be such a change for some shops. While you don't want to get stuck buying the last vestiges of a technology (tried to buy an ISA video card lately?), there's no longer a coherent case to be made for habitually riding the front part of the wave. I'm no surfer, but I hear they give points for choosing the right wave.



So planning for the future has definitely become more difficult. In the coming months, we will be giving you some new tools to analyze the likely shelf life of systems for future applications from a performance perspective. But you'll have to add to that your own calculus of business need, tolerance of (or hunger for) change, and ability to support multiple technologies.

What ever happened to the idea of a computer design you could settle on for a year?

In the long run, the industry needs to find a saner way to introduce technology. We recently did a live survey at Comdex in which 74 percent of respondents felt that technology is moving too fast. But you're not powerless in this situation. When the industry tries to force a new technology before you're ready, take the bull by the horns and let system vendors know which enhancements you can live without. In today's build-to-order world, the message will be received quickly.

Mark Schlack

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The Good Stuff

I am very thankful for all the good stuff that appears in BYTE, especially your coverage of Java. The editorial in the November 1997 issue was to the point. Also, "CORBA, Java, and the Object Web" in the October 1997 issue was excellent. I'd like to see more in-depth coverage of topics such as JavaBeans and remote method invocation (RMI).

Milan Zimmermann
mzimmerm@worldchat.com

Watch for our JavaBeans coverage in 1998.—Mark Schlack, editor in chief

Who's Out in the Cold?

"Raising the Java Standard" (November 1997 editorial) made some very good points about Java and standardization, but I don't understand this statement: "Sun executives talk quietly about revoking Microsoft's license if it ships its version of the Java classes. Who will be left out in the cold then? The few hundred thousand Java users or the hundred million Windows users?"

Actually, neither group would be left out in the cold. Such a comment implies that Microsoft is the only Java solution for Windows. In fact, there are multiple Java solutions for Windows, and only one comes from Microsoft. I agree that it would be a good thing if Microsoft were to comply with its contract; however, it's perfectly understandable why it instead chooses to spend money in court.

In addition, my company's experience is that the Microsoft Java solution is currently inferior to those provided by Sun and other vendors. We would have liked to use Microsoft Java since the compiler is very fast, but an instantaneous compiler is useless if the virtual machine is not reliable.

Dave Boydston
Solutions Consulting
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A Déjà Vu Nightmare

What a relief to find that someone else has come to the realization that Windows NT security is not secure. "Déjà Vu All Over Again" (November 1997) was fantastic! It was really nice to see someone else also note that the NT security bugs were discovered and patched in Unix long ago.

But one thing was missing from the article. A very large number of holes exist that obviate the need for password-cracking programs, ActiveX, and other tricks: Anyone who logs onto an NT machine with the default configuration has potentially hundreds of ways of gaining access as an administrator.

First, the SYSTEMROOT directory is full control for the group Everyone. This allows the replacement of Notepad.exe and other programs with a trojan horse.

FUTURE PCs: WILL INTEL TIGHTEN ITS GRIP?
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You don't even need a compiler, since you can rename it Notepad1.exe and create a batch script that adds your user to the Domain Admins group when an administrator starts Notepad from the Start menu. In addition, there are dozens of DLLs and other executables that are at least changeable by Everyone, again allowing easy creation of a trojan horse.

File associations can be changed by a user and are then effective for the administrator. Thus, the next time an administrator double-clicks on a .txt, .doc, or other file on this system, the user becomes a member of the Domain Admins group.

The worst is that this is the default state, and you need no special programming skills or tools. The holes are just there.

Jim Mohr
***Author,* Linux User's Resource**
jimmo@blitz.de

Same Nightmare, Different Bed

There's no excuse for the security problems in Windows NT, but after following computer-security issues and using Unix (as well as NT) for some time, I'm surprised to see Unix being held up as a standard. Many of the same sorts of flaws discussed in the article "Déjà Vu All Over Again" are still present in Unix 25 years later. (See ftp://info.cert.org/pub/cert_advisories.)

And because the flaws are so obvious, no one even bothers to talk much anymore about how the configuration of typical Unix-based NFS servers leaves them exposed to the simplest kinds of attacks, including those that can result in the destruction of data. By default, NFS servers simply trust—without

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requiring any cryptographic or password-based proof of identity—that their clients are who they say they are. The computer industry and computer users have a long road ahead of them to reach the goal of a truly secure computing environment.
Nathaniel Mishkin
mishkin@worldnet.att.net

RMI Lives! But Where?

In "CORBA, Java, and the Object Web" (October 1997), the authors' assertion that "JavaSoft will abandon the proprietary ORB on which RMI is currently built" is refuted by the folks at JavaSoft. If by this the authors mean that the ORB possibilities will no longer be "limited" to a proprietary Java Remote Method Protocol (JRMP), then I stand corrected. But I believe most folks would take it to mean that JavaSoft intends to join the herd and dump JRMP, which most of us have been led to believe is not true. Those who are developing under RMI and need pass-by-value capability and an "all-Java" implementation of distributed objects believe that there is a comfortable market position for RMI.
Hal Arnold
harnold@telegroup.com

JavaSoft will continue to support RMI over JRMP until the Internet Interoperable ORB Protocol (IIOP) is fully RMI-ready. This is consistent with what's stated in our article. JavaSoft will first deploy a subset of RMI on IIOP as it is today. JavaSoft is also working with Netscape/Visigenic on the OMG object pass-by-value and RMI-to-IIOP specifications. These specifications might provide the full RMI semantics over IIOP. (Netscape/Visigenic's Caffeine is an example of this architecture.) Hopefully, the specifications will have been presented—in final form—to the OMG by the time this appears in print.

When IIOP is fully RMI-ready, JavaSoft might continue to support JRMP for backward compatibility. But JavaSoft's partners intend to support RMI over IIOP only in their virtual machines. Of course, Microsoft doesn't support either. Enterprise JavaBeans support only the RMI/IIOP subset. They need IIOP to pass Java Transaction Service (JTS) transaction contexts.

JRMP is dead. Microsoft doesn't support it, and neither will BEA, IBM, Netscape, Oracle, and so forth. However, it shouldn't matter to you if IIOP is the only ORB that JavaSoft (and friends) support as long as it provides full RMI semantics. RMI will have a long life, but on top of IIOP.—Robert Orfali

Now Showing

"Batter Up for Broadband" (October 1997) states that separate dishes are required for DirecPC and DirecTV, as well as that "Hughes will someday offer a method for using one dish for both, although no target date has been announced." Actually, that system is now available: DirecDuo was unveiled on July 15.

The article also mentions that DirecPC is offered by Hughes Communications. Both DirecPC and DirecDuo are products of Hughes Network Systems, a Hughes Electronics company. For more information, see http://www.direcduo.com/.
Mitchell Derman
Edelman Public Relations
mderman@dc.edelman.com

Don't Like Your ISP?

"Batter Up for Broadband" states that "there's no dial tone, and your connection to an ISP or corporate network is hard-wired, so you won't be able to change service providers without having changes made at the phone company's CO."

This is not strictly true. Pulsecom's current ADSL product allows a user to select—using an embedded Web interface—from any number of service providers, all of which are connected at the CO via the service-access multiplexer. Individual PPP sessions are established for each user to the current service provider. Should a user wish to change his or her provider, it's just a mouse-click away.
Scott Harris
Manager, Strategic Product Development, Pulsecom
scott.harris@pulse.com

The Chip That Ate My Batteries

No sooner do battery developers give us a better power-to-weight ratio than CPU makers chew up the extra power to give us a constant 1-hour notebook-battery life. Why not give us a simpler, less powerful processor that gobbles less power?

In "Keeping It Simple" (October 1997 Core), Tom R. Halfhill says the C6 is simpler. It is neither superscalar nor superpipelined, which means fewer transistors. No branch prediction means even fewer transistors.

But for all that, the C6 has more transistors than the Pentium P55C. And, although it has more transistors, its die size is 37 percent smaller. One would think this is because caches are more regular and more dense. But 32 KB of cache accounts for maybe 800,000 transistors—not enough to account for the greater number of transistors, nor the reduction in chip size.

This article makes it look simple, but it begs many questions. And, by the time I got to the third column, it was already clear that I still do not have my wish for a suitable notebook chip.
K. C. Toh
Petaling Jaya, Malaysia

The reason why the C6 has more transistors than a P55C-series Pentium (5.4 million versus 4.5 million) is indeed the larger caches. The C6 has 32 KB each of instruction cache and data cache. It's possible to estimate how many transistors that 64 KB accounts for: 64 KB = 524,288 bits. Static RAM (SRAM) cells typically have six transistors per bit when used this way. That totals 3.1 million transistors, without considering the control logic associated with the caches.

The large proportion of transistors in the caches (more than 50 percent of the chip's total) indeed does account for the C6's tiny die size. As you correctly point out, memory occupies less space than logic because it's more dense, but you've underestimated the amount of memory.

Despite the C6's simpler design, the new Tillamook-class Pentiums still consume

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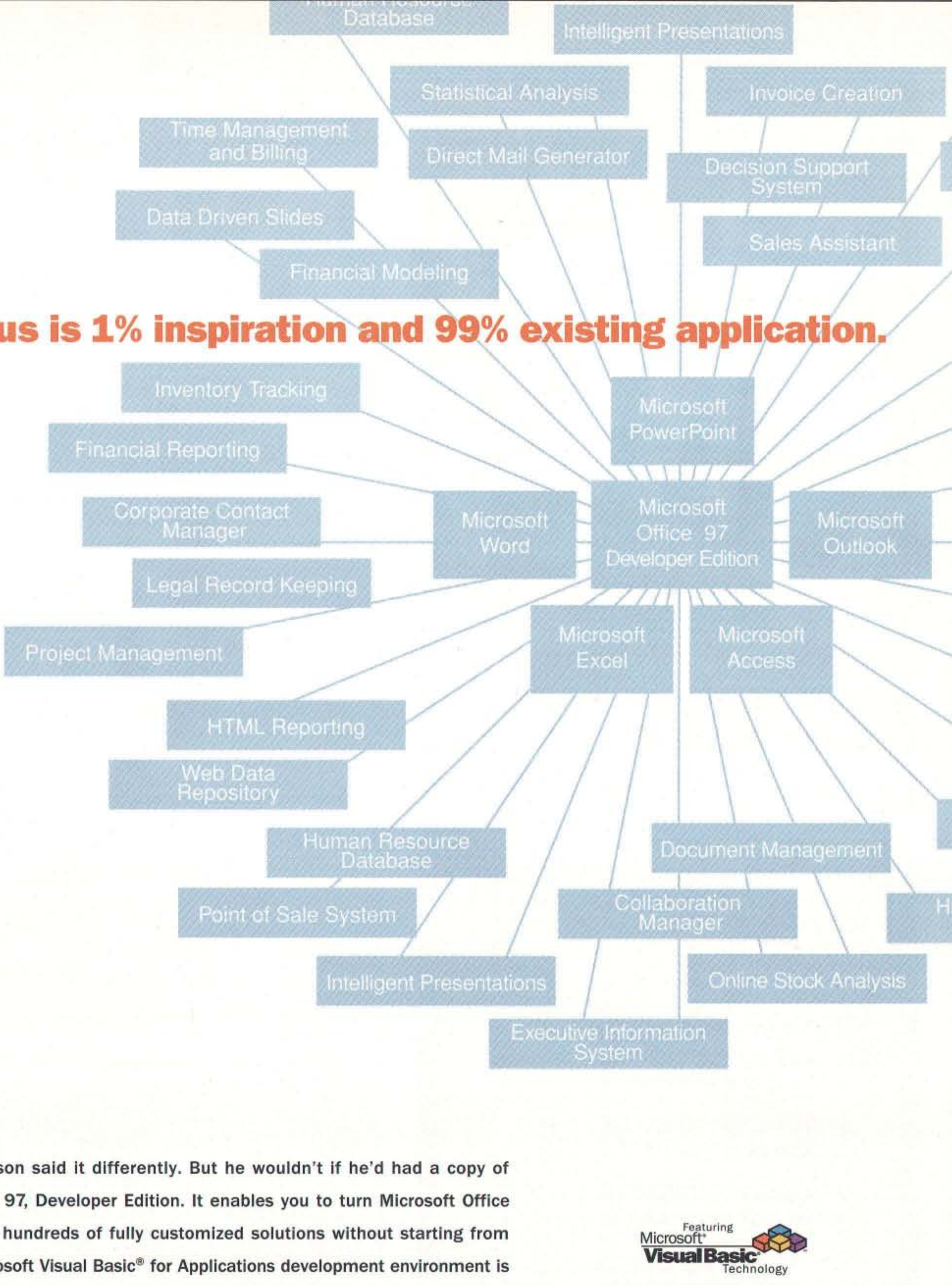
Genius is 1% inspiration and 99% existing application.



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less power at the same clock frequency. That's because the Tillamooks are manufactured on a 0.25-micron process, while the C6 is still at 0.35 micron. The Tillamook can run at a lower voltage.

You make a good point about simple designs rarely remaining simple. The C6, for instance, will add branch prediction, a better FPU, and better MMX capability this year, as well as an integrated L2 cache. However, its die size and price will remain small, because Centaur is aiming the C6 at the low-end PC market.

Note the new address for Centaur's Web site: http://www.winchip.com/.—Tom R. Halfhill, senior editor

Fixes

In "PowerSite Straddles the Object World" (January Eval), the URL given in the contact information should have been http://www.sybase.com.

In the table "Ultraportables at a Glance" (December 1997 Bits, page 28), the starting price for the IBM ThinkPad 560X was given as $1999. The correct price is approximately $4200.

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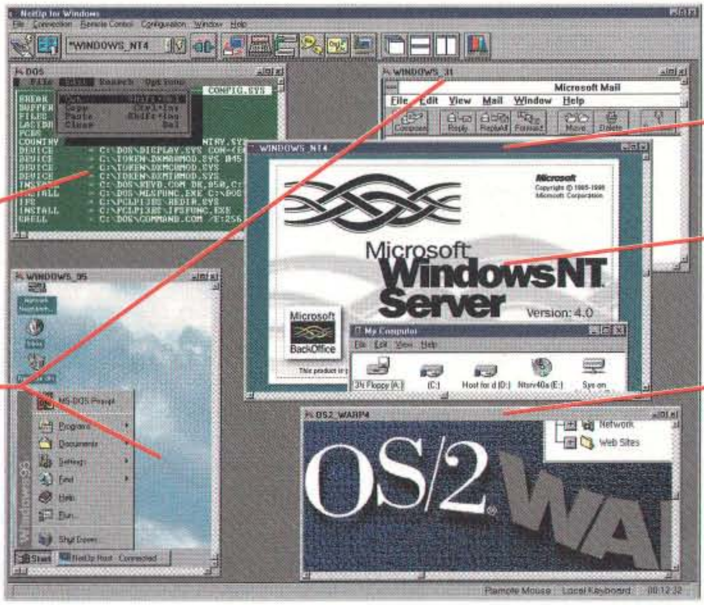

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Windows Slimfest

Several forthcoming products promise to bring thin-client computing to today's Windows applications, but experts warn: Look (and test) before you leap.

Microsoft's Terminal Server (MSTS, code-named Hydra) software promises to bring the benefits of thin-client computing to today's Windows applications. But managers who have successfully rolled out thin Windows implementations warn that you should plan and test before you deploy. And at least one Microsoft competitor, Corel, is rewriting its business applications suite to work better when running in multiuser mode.

MSTS adds multiuser capabilities and support for thin-client devices to applications that run on version 4.0 and future versions of NT Server. MSTS recently entered its first round of beta testing and is currently slated for release during the first half of this year, although that date could change, depending on how the first round of beta testing goes.

A thin MSTS implementation differs from a Java-based network computer

MultiWin: More than One Way to Skin a Cat

Microsoft's Terminal Server

All application processing occurs at the server.

Microsoft officials say that this architecture will place less strain on a network's bandwidth than a Java-based network computer, which downloads applications over the network.

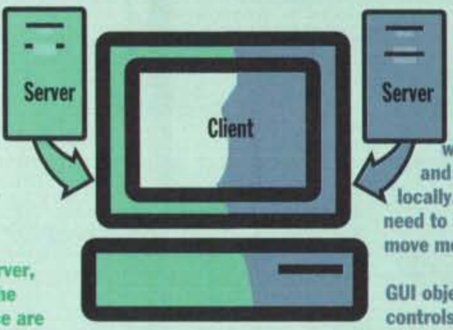
With Terminal Server, only changes to the graphical interface are sent to the client.

Corel's Remagen Technology

Most application processing still occurs at the server, but some processing occurs at the client for even more efficient network operation.

Word processor/spreadsheet editing operations are implemented via custom editing tools on the client, which process mouse and keyboard events locally. This eliminates the need to send every mouse-move message to the server.

GUI objects (e.g., toolbars, controls) that are implemented on the client as JavaBeans perform all processing and rendering locally.



Thin Windows Solutions at a Glance

Product	Server OS	Clients/apps supported	Network protocols supported	Server requirements	Server performance	Client requirements
Microsoft Terminal Server (MSTS, aka Hydra)	NT Server 4.0 (x86 version only) and future NT Server versions	Native clients for Win Workgroups 3.11, CE, 95, and NT/any "well-behaved" Win32 application	Current beta supports TCP/IP only, although this could change	32 MB of base memory, plus 4 to 8 MB per user on the server	About 15 to 25 simultaneous users per 200-MHz Pentium Pro	386-based PC with 4 MB of RAM or Windows terminal device
Corel Remagen	NT Server 4.0 and 5.0; native NT for Alpha CPU; Sun Solaris in the future	Native clients for Win 3.1, 95, and NT, plus numerous Java clients/any "well-behaved" Win32 application	TCP/IP	32 MB of base memory, plus about 6 MB for each user	At least 30 simultaneous users per 200-MHz Pentium Pro	66-MHz or faster 486 with 16 MB of RAM; moderate-speed Mac, Unix, and NC devices
Citrix pICAsso	Same as MSTS (also requires MSTS add-on)	Same as MSTS, plus Mac, Unix, OS/2, DOS, ActiveX, and Java clients/same as MSTS	TCP/IP; IPX/SPX; NetBIOS; SLIP/PPP direct/asynchronous	Same as MSTS	Same as MSTS	286 or higher; Windows terminals; NCs; appliances; wireless capability

(NC) in several key areas. For instance, an MSTS terminal doesn't download the OS or applications over the network, and it doesn't execute application logic locally. Plus, MSTS works with Windows applications that already exist.

MSTS has three components: the terminal server, the remote desktop protocol, and the terminal-server client. Microsoft says that any well-behaved 32-bit Windows application that runs on NT Server 4.0 is a candidate for multiuser deployment using MSTS. With MSTS, all application processing takes place on the server; only changes to the user interface are sent to the client.

In its base configuration, MSTS supports Windows-based terminal devices (available from a variety of vendors, including Boundless, Neoware, Network Computing Devices, and Wyse Technology, at prices as low as $500) as clients, plus PCs running Windows 3.11, 95, or NT. Support for 16-bit Windows clients means that MSTS can usher into the Windows 95 age meek, older hardware that has minimal RAM and is capable of running only Windows 3.11.

Microsoft's Windows-only client support is bolstered by a forthcoming extension to MSTS called pICAsso, from Fort Lauderdale–based Citrix (whose WinFrame technology already delivers capabilities similar to those of MSTS). pICAsso, which is slated to ship in the same time frame as MSTS, adds important enhancements, such as load balancing and support for a wide range of network protocols and non-Windows clients and devices (see the table below for more information). Both products promise to reduce the cost of ownership through centralized application management and deployment and reduced hardware costs, without requiring you to rewrite your current applications.

But it's not quite that easy. Managers who have rolled out multiuser Windows implementations based on Citrix's WinFrame say such an exercise can be positive, but you need to plan for and test a number of components before deploying successfully. The same will be true for MSTS and pICAsso, they say. One potential area of concern is the Windows applications themselves.

One issue will be whether the application you want to deploy is reentrant. If it's not, then the server must launch a separate instance of it for each simultaneous user, which can quickly add up to a major load on the server.

In addition, Microsoft says that applications must be written correctly to run on MSTS. They need to properly separate global registry data from local (i.e., user) registry data, store user-preference files in the correct directories, and so on. Microsoft officials admit that they don't know how many of today's applications will work correctly in an MSTS environment. "That's one of the things we'll be looking at during Hydra's beta testing," says Craig Cumberland, Windows NT Server product manager.

Another consideration: With MSTS and other MultiWin environments, all graphical output and keyboard/mouse input flows over the network. Overlaid images, on-screen animation, and splash screens take longer to display over the network on an MSTS client. And memory leaks, which are troublesome enough in a single-user environment, are intensified in a multiuser environment. These troubles are serious enough that, as men-

Availability	Price
Slated for release in first half of 1998	To be determined, but similar to other BackOffice programs
First half of 1998	To be determined, but probably less expensive than MSTS
First half of 1998	To be determined

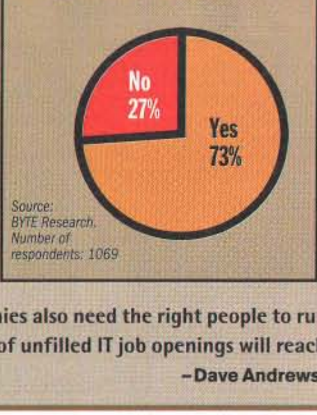
Geek Mystique

Enhanced Mystique

Computer experts are in high demand today—and that demand, along with the pace of technology change, should increase over the next few years.

Already most people think technology is evolving too quickly. In a recent survey conducted by BYTE Research at Comdex Fall '97 in Las Vegas, the majority of respondents said they believe technology is moving too fast for the average person to keep up (see the figure at right for more details). But according to a recent issue of the IT Metrics Strategies (ITMS) newsletter, which is published by Cutter Information Group (http://www.cutter.com/itgroup/), the pace of technology acquisitions by business will accelerate in the years ahead. By the year 2005, according to the report, each year will be the equivalent of the entire 1980s twice over in terms of information-technology (IT) infusion by U.S. corporations.

Does High Tech Move Too Fast for the Average Joe?



Source: BYTE Research. Number of respondents: 1069

Howard Rubin, ITMS editor, points out that simply acquiring raw technology isn't enough: Companies also need the right people to run systems. In addition, Rubin estimates, the number of unfilled IT job openings will reach 350,000 by the end of 1998.

–Dave Andrews

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tioned earlier, Corel is currently rewriting some of its applications for smoother multiuser performance.

"With today's Windows applications, there's a lot of unnecessary redrawing and other activity that goes on," says Paul Skillen. He is the director of software development at Corel, whose multiuser Remagen technology will be bundled with WordPerfect Suite 8, Enterprise Edition, an applications suite being rewritten for multiuser deployment and slated to ship this year (see the table for more information). "If you're using [current] Windows applications in stand-alone mode, you don't notice all this activity, but if it occurs over a network, applications can run a lot slower."

Making sure your application runs efficiently in a MultiWin scenario is just one of the things you need to consider, according to George Morris, senior LAN specialist at Bell Mobility. "Network capacity, network latency, the process for rolling out applications, application performance—these all need to be evaluated," he says. Morris adds that his company currently has approximately 120 WinFrame 1.6 servers in two production clusters and that Windows-based terminals can be an inexpensive and reliable way to deploy Windows applications. "It can be extremely positive, provided it's been designed properly," he explains. "But you have to take a systems approach. This is not just another PC that you're dropping on the desktop."

Microsoft officials say that once MSTS is commercially available, applications will have to run correctly with the technology in order to qualify to bear the Windows logo. This is welcome news for current WinFrame users, as the logo will indicate that an application works correctly in multiuser mode. Says Bell Mobility's Morris: "It sure would make life a lot less painful." **–D. A.**

I_2O Getting Ready to Go

As vendors continue to prepare and test forthcoming I_2O software and hardware, the I_2O special-interest group (SIG) is considering making additions to the current standard to make it more appealing to enterprise computing.

I_2O, which stands for intelligent input/output, promises to increase PC server performance by reducing the main system processor's involvement in I/O functions. By having an I_2O processor, such as Intel's 960, relieve the main CPU from the burden of handling I/O-related activity, such as interrupts, I_2O promises to improve overall server performance. I_2O's modular software architecture also promises greater drive stability and more flexibility and competition in the server arena.

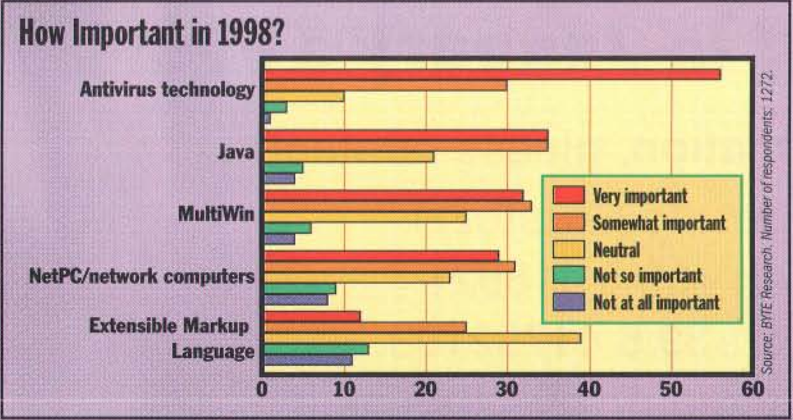
But exactly what the performance improvement is, or how flexible I_2O will be in the real world, remains to be seen. At press time, Microsoft, Novell, and SCO were preparing to release either

Future Watch

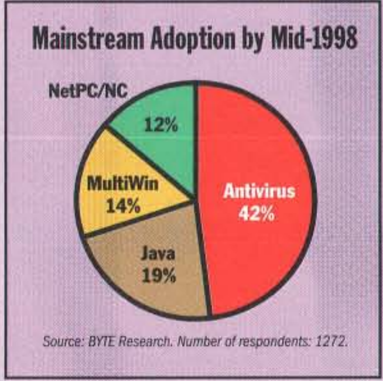
Java, NCs, MultiWin Rank High Among Top Technologies for 1998

Although they weren't rated quite as high in importance as antivirus technology by respondents to a recent survey conducted by BYTE Research, Java, Multiuser Windows (MultiWin), and network computers (NCs) were ranked among the top technologies for 1998. Java ranked ninth overall, and MultiWin (eleventh) and NetPC/NCs (fifteenth) weren't far behind. By way of comparison, Extensible Markup Language (XML) was ranked twenty-fifth overall by respondents; antivirus technology was ranked first. Although MultiWin isn't a new technology, it has attracted quite a bit of attention lately due to Microsoft's beta release of its first Terminal Server software for implementing multiuser Windows on NT Server.

The majority of the survey respondents didn't predict the mainstream use of Java, NCs, or MultiWin during the first half of 1998: As the figure "Mainstream Adoption by Mid-1998" illustrates, Java, the highest-scoring of these three technologies, scored just 19 percent in this regard, compared to 42 percent for antivirus technology. The implication: Many users are interested in Java, MultiWin, and NCs, but they still need to evaluate these technologies before making an organization-wide commitment to them.


How Important in 1998?

Source: BYTE Research. Number of respondents: 1272.


Mainstream Adoption by Mid-1998

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new or updated OSes with I_2O support.

One benefit of I_2O is the ability to scale servers. "Servers that do not have intelligent adapters spend a tremendous amount of CPU power managing the I/O in the system," says Harry Mason, director of host marketing at Symbios, which is developing numerous I_2O products. "Often a user finds that he or she has adequate performance in a server [in its original configuration] but finds that the system bogs down when additional host adapters or more LAN cards are added."

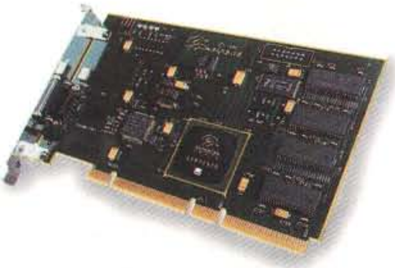
Mason estimates that with traditional device drivers and nonintelligent adapters, you could expect to see 8000 or more I/Os per second in today's Pentium Pro–class machine. At those levels, the machine might use close to 90 percent of the available CPU performance.

But with I_2O and other intelligent approaches, a server might only use 40 percent of its CPU power for 8000 I/Os, and adding more storage-adapter cards could allow the system to scale to well beyond 20,000 I/Os before saturating the CPU. "This ability to grow the server to serve a wider range of departmental or enterprise needs—and to do this in the environment of industry-supported standards—is the real value that I_2O provides to the end user," says Mason.

However, the concept of off-loading I/O tasks from the main CPU is not a new one. Supercomputers, mainframes, and other big-iron systems have done it for years. "I_2O is not doing anything more than intelligent peripherals have been doing for some time," says Keith McAuliffe, vice president of engineering in Compaq's server-product division. "I_2O does not make an equivalent [non-I_2O] implementation go faster." What it does do, according to McAuliffe, is establish an infrastructure that will permit hardware and software vendors to spend more time innovating and less time rewriting drivers.

Currently, in a non-I_2O scenario, a hardware vendor has to write, integrate, test, and distribute a device driver for each OS and OS revision, each new controller board, and sometimes revisions of the controller. I_2O's split-driver model can potentially eliminate all that busywork. With I_2O, an OS vendor, such as I_2O SIG member Microsoft, Novell, or SCO, writes an OS-specific module (OSM) for each class of device supported.

Then, companies making devices such as SCSI adapters, hard drives, and network interface cards (NICs) write one driver that works with any I_2O-compliant OS that supports that class of device. "We would rather see innovation in other areas than have to use programmers' time to write and rewrite drivers for different OSes," says Tamar Newberger, director of product management for UnixWare 7 at SCO.



The new Symbios I_2O adapter supports Fibre Channel with faster 64-bit PCI.

Proponents say that I_2O, by freeing vendors from the chore of writing and rewriting their drivers, could result in a more horizontal PC industry, where every layer has competition. Vendors would be able to concentrate on writing the best driver or the best RAID software.

The latter is exactly what Mylex hopes to do with the I_2O RAID software it plans to release in the first quarter of this year. "Thanks to the modularity of I_2O, our RAID software doesn't have to be intertwined with the SCSI chip," says Doug Fields, senior product-marketing manager for Mylex. "The software does not have to know the details of the hardware, so you can use it with a variety of SCSI chips." And, by taking advantage of the i960, Mylex's RAID software can deliver better performance than a software-only solution.

Vendors caution that I_2O will not eliminate the need to write native device drivers, as I_2O is not supported in Win 95, nor will it be supported in Win 98. In addition, due to the enterprise nature of I_2O, software programs will require extensive testing before they are released, which could slow products' commercial arrival.

Meanwhile, I_2O members are discussing adding even more features to future versions of I_2O that will make it more robust. These features include support for peer-to-peer (where a NIC gets a file from a Web server's hard drive with minimal interruption to the CPU), Fibre Channel, clustering, ATM, WANs, and the hot replacement of peripherals. **–D. A.**

Bug of the Month

Your CPU Could Be Turned Against You

The recently discovered "FO bug" causes Pentium- and Pentium with MMX–based systems to crash when a few lines of innocent-looking machine code—F0 0F C7 C8—are sent to the CPU. It's unlikely for this code to appear in any commercial software because it doesn't convey a useful executable command. However, it offers hackers a new mechanism with which to launch malicious programs against systems and servers. This bug can occur regardless of what OS a system is running.

The illegal instruction is a 64-bit value that the processor tries to stuff into a 32-bit register. When a register is used as a destination, a processor normally stops such an instruction, signals an error, and prompts an error handler in software. According to Manny Vara, spokesman for Intel, "Basically, in this case the problem is that this code sequence doesn't raise a flag that something's wrong." A crash occurs if the instruction is locked, which means it gets completed without interruption, the invalid register is used, and the CPU hangs. On single-user systems, this is probably not a significant threat. But on servers executing uploaded CGI programs, this could be a serious security hole.

Intel has posted information on its Web site (http://support.intel.com/support) about how OS vendors can fix this problem. These workarounds generate a page fault when the invalid exception occurs, avoiding the bus-lock condition and allowing the processor to execute the error handler.

As this article went to press, all the major commercial OS vendors had pledged to work with Intel on creating fixes, but they hadn't yet made their implementations available for their customers. However, a patch for Linux-based systems is already available at ftp://ftp.kernel.org/pub/linux/kernel/.

–Jason K. Krause

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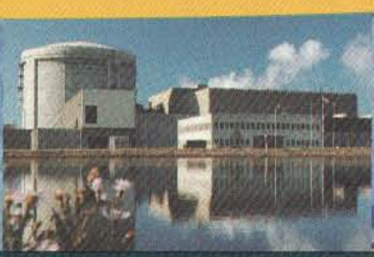

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USB Products Arrive in Force

Months after the first PCs with universal serial bus (USB) ports started shipping, peripherals for the low-to-mid-speed peripheral-connection bus are finally becoming widely available. At the same time, vendors are developing products and solutions that allow older PCs and peripherals to plug into the USB environment.

Central Data's new USB port server brings USB to existing serial devices.

A variety of USB products—ranging from keyboards, joysticks, and mice to USB ports, videoconferencing cameras, monitors, and other peripherals—were shipping or expected to begin shipping by the end of 1997. Some of these products include new USB speakers from Altec Lansing; new videoconferencing cameras, including Kodak's DVC300 (about $199); Xirlink's $199 Video Phone; and Connectix's QuickCam. Also available for USB are monitors (including flat-panel displays) from Compaq, Mitsubishi, Samsung, and others.

USB enables you to connect as many as 127 USB devices to your system; its total bandwidth of 12 Mbps is sufficient for low- to medium-speed peripherals, such as keyboards, mice, joysticks, scanners, cameras, phones, monitors, and so on. The technology allows you to plug and unplug devices to and from a system, and it will eventually eliminate the need to have multiple parallel and serial ports coming out of the back of your PC.

Other benefits of USB vary, depending on the product. For example, Xirlink officials say the company's Video Phone camera can deliver improved frame rates, not only because of its on-board video-compression chip but because one mode of USB guarantees delivery for time-sensitive applications, such as videoconferencing.

Another benefit: With monitors such as Samsung's SyncMaster 700Up 17-inch CRT (with 15.7 inches of viewable area, $1019), there's no need to twiddle knobs to adjust the image; instead, you do all the necessary adjustments via the mouse or the keyboard. The monitor also has three powered USB ports. This lets the monitor act as a hub for other USB devices without requiring each device to have a separate power cord.

Expect to see USB keyboards coming out with on-board USB ports, too, although many keyboard makers are waiting for less-expensive single-chip solutions (e.g., USB controller and hub chips combined) to arrive from the likes of Intel and Cypress Semiconductor. USB game devices, such as Alps's forthcoming GamePad, which supports a wide variety of PC games, will benefit from USB's support for multiplayer participation.

PC telephony can also benefit from USB, says Bill Beck, head of the Mitel Personal Assistant Program at Mitel (Kanata, Ontario, Canada), which plans to release two new USB-enabled PC phones in the second quarter of this year. Mitel's single- and dual-line phones will join the company's already-available "USB-ready" Personal Assistant product, which adds computer telephony to

More products are available that plug into USB.

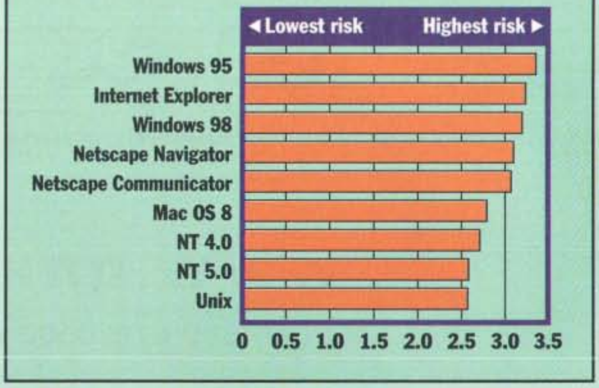
Survey

Windows 95 Ranks Low in Security

Windows 95 is a popular OS, but users don't rate it as highly as other OSes when it comes to security. According to a recent survey performed by BYTE Research, users ranked Win 95 as the OS or application with the highest security risk.

Due to the security holes in Win 95, Netscape Navigator, and Internet Explorer that have been documented and publicized over the past couple of years, it's not surprising that those products were rated as high security threats. What is somewhat surprising is that Win 98—the next version of Windows—was also deemed a relatively high security risk. Win 98 will have new features, such as security zones, that let IS managers or users set different default security policies for different classes of sites (e.g., intranet, trusted Web sites, Internet, and restricted Web sites). But respondents are either unimpressed with or uninformed about those features. Unix was deemed as the lowest security threat, although NT 5.0 was a very close second.

What App/OS Is the Highest Security Threat?



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CMD's PCI-to-USB CSA-6700 card lets new USB devices work with older PCs.

your PC. "With USB, you can open multiple virtual channels into the PC," Beck says. This means that if you have dual-line support in your telephony-enabled PC, USB's bandwidth will let two people leave separate voice messages simultaneously, instead of one having to wait until the other is finished. USB, combined with improved network support for voice traffic, will also improve the quality of voice-over-IP applications.

But several caveats exist with USB. For one, the version of Windows that you use might not support USB. USB currently works only with the newer version of Windows 95, called OSR 2.1, that started shipping on new PCs early in 1997. If you're uncertain whether your version of Win 95 supports USB, go to the System Properties menu in the Control Panel to check the version of Win 95 that's installed on your system. If you have version 4.00950B or later, then your machine is USB ready.

Furthermore, if it's not relatively new, your PC might not have USB ports. And what about your old peripherals? Luckily, several vendors provide solutions for bringing older equipment up to speed with USB.

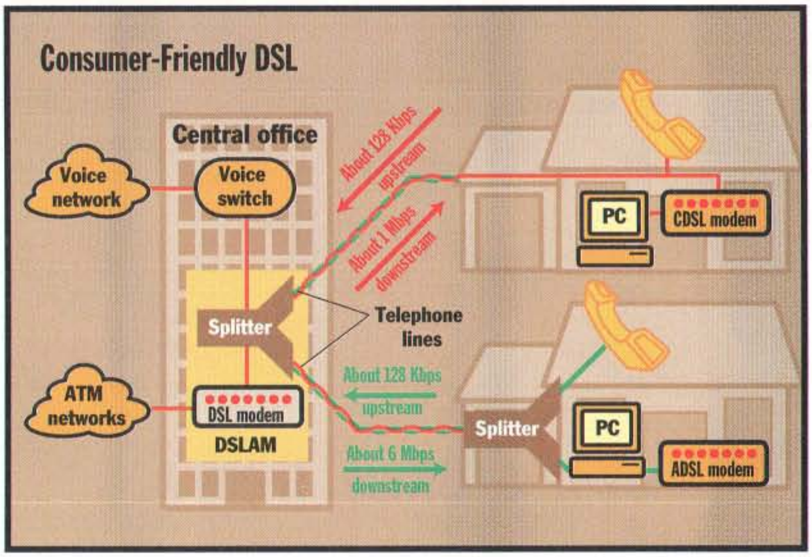
One such company is CMD Technology (Irvine, CA). Its CSA-6700 PCI-to-USB controller board lets peripheral vendors bundle a new USB device with a PCI card that adds two USB ports. The company is also providing vendors with a device-driver kit for the board that lets vendors write a driver that will work with older versions of Windows 3.x and 95, as well as other OSes.

Another company providing legacy support is Central Data (Champaign, IL), with its USB Port Server. This product lets existing serial devices, such as printers and modems, connect to USB. Why would you want to do that? One reason is interrupts, which can become scarce on a PC because they're needed by sound cards, modems, Ethernet controllers, and other devices. Connecting four serial devices to a USB hub takes only one interrupt in your PC, according to Mark Decker, a spokesman for Central Data. Another product, from Northstar Systems (Rancho Cucamonga, CA), lets you connect parallel devices to USB ports.

Some vendors will delay releasing USB products to the retail channel until Win 98, which will have full support for USB devices, ships. But for folks with USB today, products are here. **–D. A.**

DSL Gets Consumer-Friendly

An emerging new version of the digital subscriber line (DSL) technology promises to deliver faster Web access in a package that's easy for consumers and service providers alike to implement. But, as usual, standards are an issue. Whether it's Rockwell's CDSL (the *C* stands for consumer), Aware's DSL Lite, or another implementation of the technology, the basic idea is the same: Make DSL available in a package that doesn't require a splitter at the customer's house or work site.



A future version of DSL, without the splitter, could be easier to roll out to end users.

With full-rate ADSL (the *A* stands for asymmetric), a splitter is required to prevent interference between the phone service and the DSL service on the same copper line. That means someone from the DSL service provider needs to travel to a customer's site to install the splitter equipment, which increases the cost to the provider attempting to roll out DSL service.

The "lighter" version of DSL eliminates the need for a splitter by relying on signal-processing techniques to filter out interference. Another benefit: The light version of DSL could be implemented in a software-only solution on a Pentium-based or faster PC, or in a modem that end users can buy through normal retail channels. Dual-mode modems could even support DSL light and regular 33.3- or 56-Kbps analog connections. Such modems would get DSL service providers out of the business of supplying—and supporting—their end users' access equipment.

One caveat with these lighter DSL implementations is slower connections—about 1 Mbps downstream to the customer, compared to about 6 Mbps with

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660CDT 5/150 16MB 1.2GB 11.3" AM 10X	2178.59

Tecra notebooks

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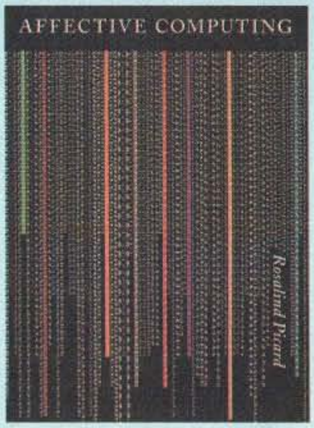
Book Reviews

A Computer to Love

Imagine you're nervous about an upcoming presentation. Your computer senses your fast heartbeat, the sweat on your palms, and your halting speech. It scans your schedule and deduces the cause of your concern. It then calls up positive e-mail that you received after your last presentation and offers helpful pointers for delivering a relaxed, effective speech. Sensing that your confidence is growing, the computer loads up the presentation you've been preparing, suggests an opening joke for breaking the ice, and asks if you'd like to practice. You watch your image on the screen as you deliver the presentation, also noting the feedback about your pacing, intonation, speech clarity, and physical responses. Your computer laughs heartily at your opening joke and responds enthusiastically to your best points. You thank your computer for the help.



As we embrace the idea of personal assistants, intelligent agents, and computers that understand our needs, work styles, and preferences, we must consider instilling computers with emotional intelligence. As Rosalind Picard points out in her book *Affective Computing*, although we're conditioned to view emotions as a hindrance to clear reasoning and intelligent judgments, research supports the importance of emotions in critical thinking. Computers are little more than savants, and yet we expect them to behave like human assistants. A truly personal, interactive system must learn to associate relevance and context to the facts it holds and to make judgments based on experience and intuition.

The first part of the book covers current research on human emotion, delving into the mystery of what makes up emotions and how to recognize, test, and differentiate among a range of emotional states. Picard makes a convincing argument about the role of emotions in intelligence and suggests some compelling applications, such as computer interfaces, tutorials, and personal data assistants. Correctly developed and applied, emotions could enrich the computing experience and advance it to new levels of utility.

Of course, human emotion, especially in intricate areas such as creativity, is not well understood. Building emotions into computers can seem like a daunting challenge. I certainly sensed the forbidding complexity of the problem as I read the book. The most encouraging areas of research, at least in the near term, involve emotional recognition and imitation. In the aforementioned presentation scenario, a truly emotive computer would not be required. The system would need only to infer a likely emotional state by monitoring your physical responses and then react in an emotionally supportive way. Sensors in a computer could track discrete signals, such as electromyograph (EMG) waves, blood-volume pressure, galvanic skin response, and respiration, to infer emotional states. The next step is to map emotional patterns to appropriate reactions by the computer.

Researchers are applying a variety of theories about human emotions to computer architectures. Picard depicts many models in the book, "deliberately not trying to establish one model or one theory of emotion." Again, it's the nebulous nature of emotion itself that constricts her; after all, there is not "sufficient understanding of human emotions to justify a comprehensive model at the level needed for computer implementation."

This book works best as a solid framework for ongoing research and development. Picard offers criteria for quantifying emotional intelligence, for verifying its effectiveness in computers, for recognizing the properties of emotional behavior and implementing appropriate computer responses, and for characterizing affective patterns and recognizing them algorithmically. She also lays the important groundwork for building the models and software architectures of the future.

I might only suggest that Picard should have used fewer references to the homicidal HAL from *2001: A Space Odyssey*. Every time I launch my Web agent, I keep hearing HAL's ominous echo: "I'm afraid, I'm afraid, I'm afraid...."

Stanford Diehl *is a frequent contributor to BYTE and former director of BYTE reviews. You can reach him at Sdiehl@nebs.com.*

Affective Computing by Rosalind Picard; The MIT Press, 1997; 275 pages; ISBN 0-262-16170-2; $27.50 (cloth)

ADSL. But with more-capable digital signal processors (DSPs) or, in the case of a software-only implementation, faster CPUs, the speed of DSL light could improve. Even so, this version of DSL is faster than analog modems and ISDN, and it provides an easy upward migration path to full-rate ADSL, provided that the customer's and central office's equipment are based on the same standard.

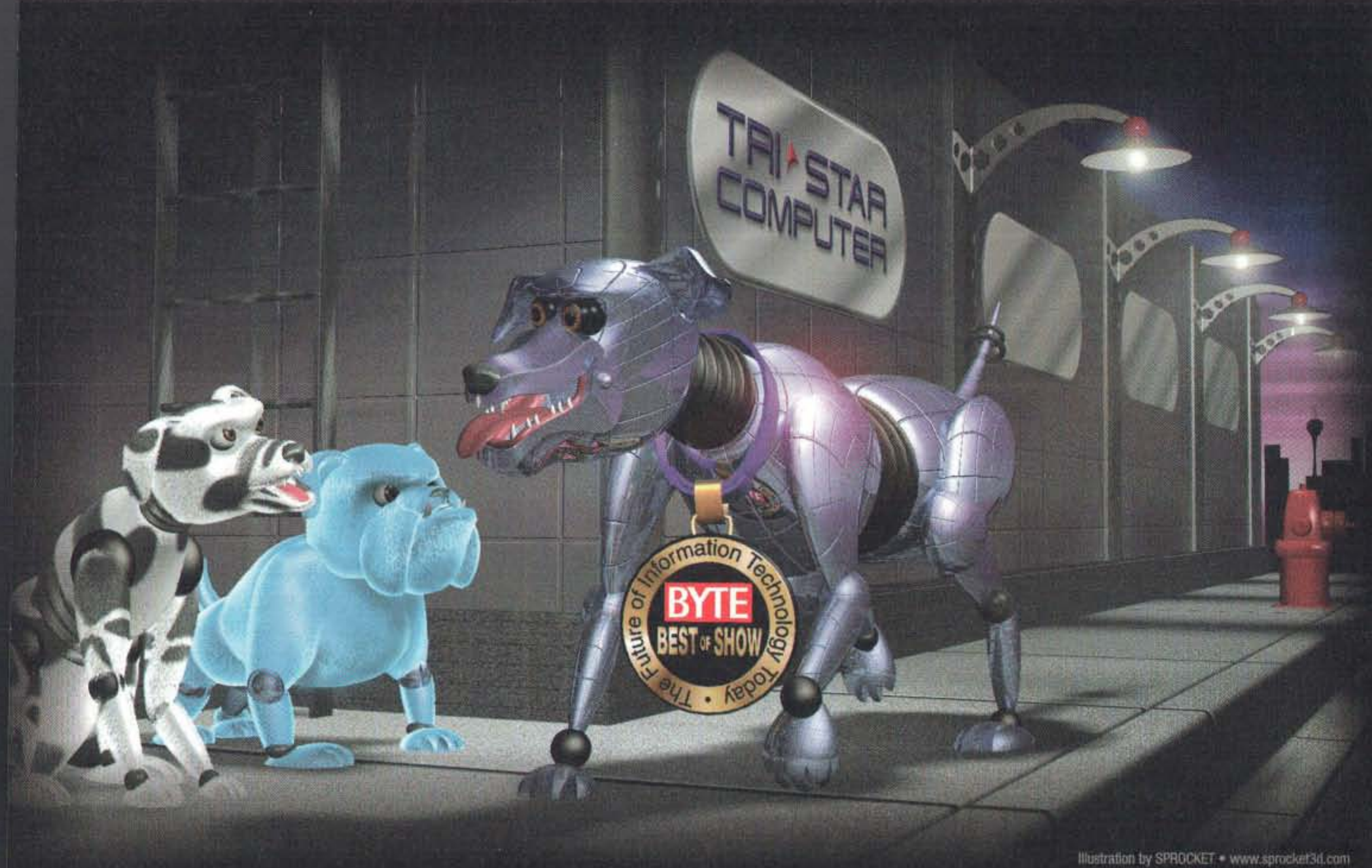
Another caveat is the question of standards. Aware and other companies base their line-encoding schemes on the discrete multitone (DMT) standard, but Rockwell says its CDSL scheme is based on a proprietary line-encoding standard.

In addition, vendors worry that if the International Telecommunications Union (ITU) group responsible for setting the new standard for this brand of DSL adopts something other than DMT, it will hinder acceptance. "If the ITU chooses something that's not DMT, that could result in years of work getting delayed," says Greg Whelan, director of business development at Aware. If this new DSL is based on DMT, that would provide an easy migration path to faster DSL speeds, DMT proponents say.

Whelan comments that adding the proper equipment for DSL at each central-office site is a big enough commitment for telephone companies and that it's unlikely the phone companies would want to support two standards: DMT and something else. (Rockwell officials say that although their initial proposal to the ITU is not based on DMT, they will adopt whatever the standard is; DMT proponents will lobby to ensure that a DSL-light standard is based on DMT).

When such modems will appear is currently unclear. Rockwell and Toronto-based Northern Telecom recently announced that they will offer a CDSL modem for about $200 in the second half of this year, but other vendors, such as Aware, could offer them sooner. **–D. A.**

You've Heard The Big Dogs Bark, [Arf]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Blasts from the Past

5 Years ago in BYTE

BYTE
Create CD-ROMs on Your Desktop

Prices have dropped by a few thousand dollars since we wrote about the first "affordable" CD Recordable (CD-R) drives, which sold, with recording software, for $8995 and up. Other topics covered in this issue: Lotus Improv; interactive TV; SunSelect's WABI technology, for running Windows applications on Unix; fax servers; AT&T's Hobbit; and the EO personal communications systems.

10 Years ago in BYTE

BYTE reviewed seven memory boards for IBM's new Micro Channel bus. Also reviewed: Word 4.0 for MS-DOS; Agenda, a free-form database manager from Lotus; and HP's Portable Vectra (weight, 16.6 pounds; price, $2495, plus $450 for the optional 1200-bps modem).

15 Years ago in BYTE

Apple's Lisa computer received a complimentary write-up, but BYTE author Gregg Williams voiced concern over the system's $9995 price tag, saying "...most people would be incredibly interested in a similar but less expensive machine." The first Mac made its public debut about a year later.

20 Years ago in BYTE

A look at stepper motors, musings on Boolean algebra, and the second in a series of articles about how the brain works (the brain is a great deal more mysterious than a computer) were just some of the stories included in this issue.

Unified Software Building Blocks

Rational Software's Jerry Rudisin discusses the present and future of component-based development.

BYTE: *How are components changing, and how are they changing the way that software is developed?*

Rudisin: Component-based development is causing a sea change in the way software is developed. Industry analysts project that by 1999, components on Unix and Windows, and with a wide range of implementation technologies, will become the standard way of thinking about building software.

Software today is like hardware was 30 years ago. Back then, transistors were a form of component, but they were very limited and simple. You could build small-scale electronic systems, but [the process] wasn't scalable, and it was primitive.

Integrated circuits came along, then the CPU. These more advanced technologies were built on transistors. The level of abstraction and power increased substantially, along with ease of use. There's a strong analogy between what happened in hardware and what is happening in software. Components build upon the object building block; they tend to go beyond individual objects. A whole billing subsystem for a cell-phone company, which could have hundreds of separate objects in it, can be a component. Modules that sit on top of a core database are another example of components.

What's happening now is that components are getting standardized. CORBA can tie together components using standard message passing and talk to ActiveX on the other side.

BYTE: *How does the Unified Modeling Language fit in with this trend?*

Rudisin: Using the hardware example again, there's only one notation used to design electronic circuits. Until recently, there was no standard way of expressing how software components are defined, what the interfaces were, and how the pieces could snap together. Instead, you had a lot of different methodologies: Coad-Yourdon, Booch, Object-Modeling Technique, Shlaer-Mellor, and so on. What we saw is that people liked the idea of object technology, but the absence of any common language was a real impediment to the rapid growth of the market.

Rational Software set out to remove this fragmentation and drive the creation of a single, open standard for describing objects and components. That's now called the Unified Modeling Language, which the Object Management Group has formally accepted as a standard.

BYTE: *What does that mean for programmers?*

Rudisin: We now have the equivalent in the software world of the standards for circuit design or for describing how buildings are built. It's one of the few things that Microsoft, Oracle, and IBM agree on. So, if you're building an application with components from IBM, Microsoft, or Oracle, before, it was awkward to model a system that had a CORBA and ActiveX piece. Now, with UML being a universally adopted standard, it's a lot easier to design and model systems that have components from any one of those sources.

BYTE: *How is Rational delivering UML technology to the market?*

Rudisin: We're building a strong family of tools to automate different elements of component-based development—for example, modeling the requirements for a system, modeling the component, doing various kinds of software-quality testing, automating configuration-management aspects of software, and automating the software process.

BYTE EXTRA

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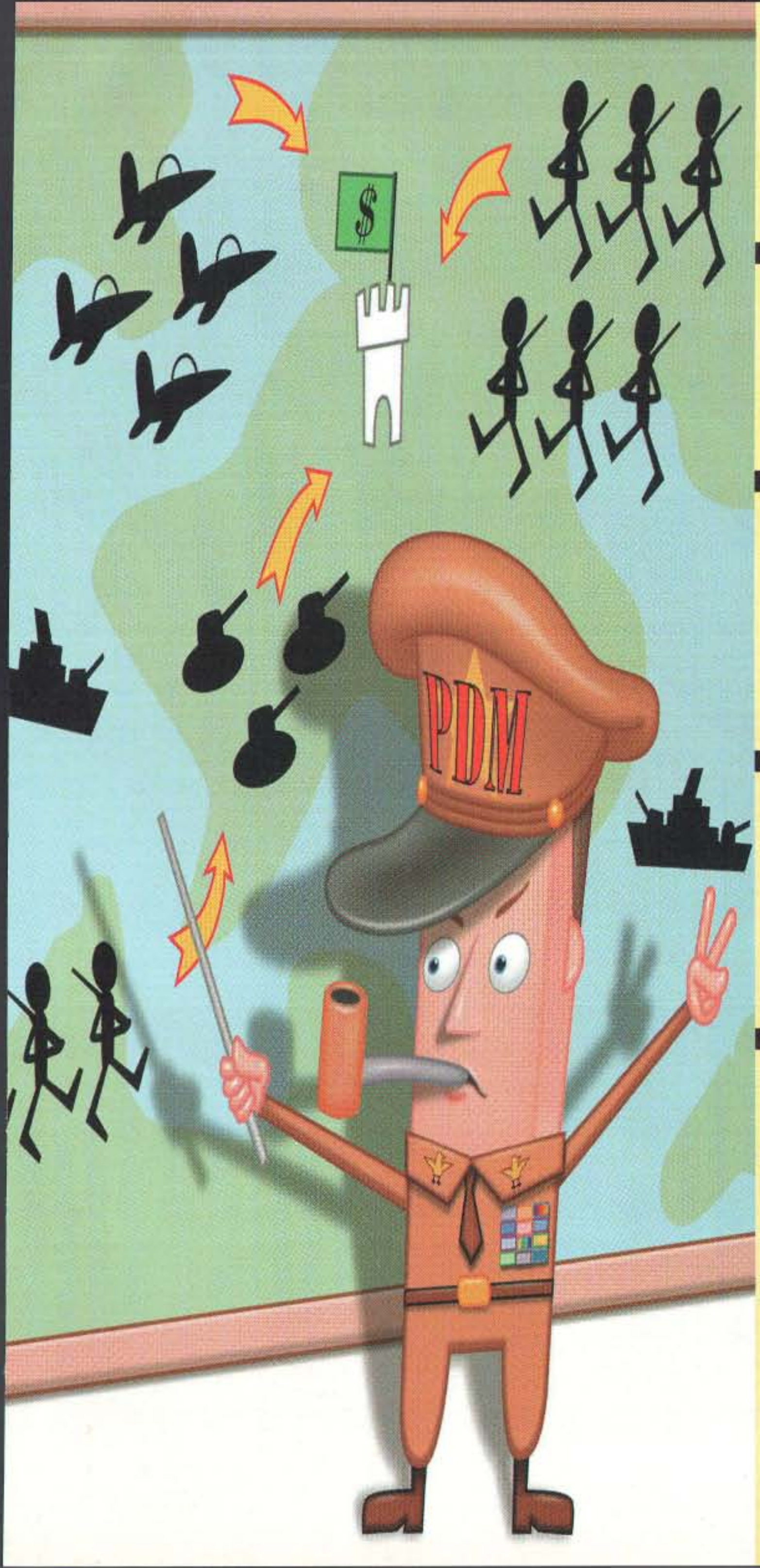

Higher-Quality Audio
Audio applications that can adapt to Internet congestion. Page 40IS 3

Alpha's Future
What the Intel deal means. Page 40IS 4

Smarter Smartcards
Multiple applications running on one smartcard. Page 40IS 7

I2O's Promise
Better performance, lower prices than some Unix servers. Page 40IS 11

Product Data Management
Companies can increase productivity by integrating PDM. Page 40IS 16

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News & Views

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Lahey Fortran 90 4.0

Lahey Moves Towards Fortran 95

Lahey Fortran 90 4.0 includes a native, 32-bit Windows compiler and other tools which offer improved performance under Windows NT. The new Winteracter Starter Kit allows you to create true Windows user-interfaces for your scientific and engineering code. Moving towards Fortran 95, LF90 4.0 adds CPU_TIME and updates the intrinsic functions CEILING, FLOOR, MAXLOC, MINLOC, MAXVAL, MINVAL, PRODUCT and SUM.

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With the JBuilder Client/Server Suite you can deliver scalable multi-tier applications with full support for RMI and CORBA. Manage all your corporate data with robust database tools and components and complete JDBC connectivity. You get everything in JBuilder Professional plus: RMI, PVCS Version Manager, Visigenic VisiBroker for CORBA, InterBase NT, Visual Query Builder, SQL Explorer and SQL Monitor, and high-speed native drivers for Oracle, Sybase, Informix, DB2, InterBase, SQL Server, Access, FoxPro, Paradox, and dBASE. In addition, you get the complete source code of a sample multi-tier CORBA reference application.

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Arity/Prolog32 for Win32 provides a complete Prolog programming environment in which you can write, debug, and run Prolog programs in the Windows 95 and NT environments. Arity/Prolog32 for Win32 is a powerful, highly optimised, and extended version of the logic programming language Prolog with a complete compiler and interpreter written in Prolog, C, and assembler and is a superset of Clocksin and Mellish Prolog.

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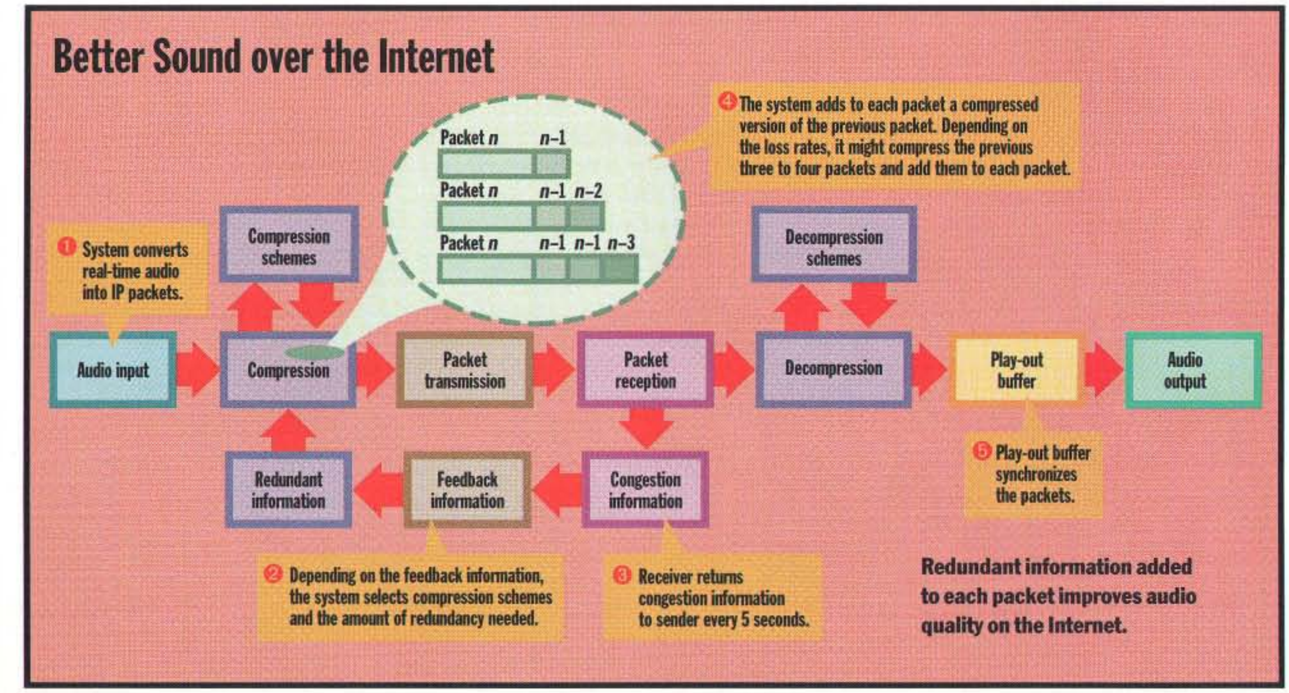

Better Sound over the Internet

❶ System converts real-time audio into IP packets.

❷ Depending on the feedback information, the system selects compression schemes and the amount of redundancy needed.

❸ Receiver returns congestion information to sender every 5 seconds.

❹ The system adds to each packet a compressed version of the previous packet. Depending on the loss rates, it might compress the previous three to four packets and add them to each packet.

❺ Play-out buffer synchronizes the packets.

Redundant information added to each packet improves audio quality on the Internet.

The architecture of the Internet is not a good environment for real-time audio and video transmissions. The delay between the arrival of subsequent packets, known as jitter, depends on the traffic conditions on the Net. Packet-loss rates often vary between 15 percent and 40 percent. Delays between packets can be as much as 1.5 seconds, seriously compromising the quality of conversation over the Net.

New protocols, such as the Resource Reservation Protocol (RSVP) and the Real Time Transport Protocol (RTP), might eventually improve the quality of service on the Net. However, they are not yet widely used.

Another approach is to adapt applications to the jitter present on the network. A group of researchers at the French National Research Institute, INRIA (Sophia-Antipolis), has developed an extended, adaptive loss-recovery and rate-control system that gives reasonable quality to audio transmissions with loss rates as high as 50 percent.

The INRIA audio tool adjusts the audio packet send rate to the current network conditions, adds redundant information to packets when the loss rate surpasses a certain level, and establishes a feedback channel to control the send rate and redundant information. Simply put, the scheme minimizes the impact of packet loss and delay between subsequent packets on perceived audio quality.

In a process called forward error correction (FEC), the system adds to each packet a highly compressed version of the previous packet. When the network load and packet-loss rates are high, the process increases the amount of redundancy carried in each packet. It does this by adding to each packet compressed versions of the previous three to four packets.

The complete process is controlled by a feedback loop that gradually increases the send rate if the loss rate is above a certain threshold. In 5-second intervals, the receiver returns quality-of-service reports to the sender to adapt the amount of redundant information being sent.

"Adaptive internet telephony might eventually provide better voice quality than the standard 8-kHz sampling on today's telephone networks," says Jean-Chrysostome Bolot, a project manager at INRIA.

–Rainer Mauth

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Alpha's Future

What the Intel deal means.

Digital Equipment's Alpha architecture has been the CPU performance leader for almost the entire time since its arrival in 1992, and it's the only non-x86 NT architecture. Yet it accounts for a relatively small share of the workstation and server markets. Will the recent Digital-Intel settlement change anything?

In this settlement, Intel licensed the right to use Alpha technology (which remains under Digital ownership) and its related patents. The company also purchased the Digital Semiconductor manufacturing and sales operation. This settled the existing patent-infringement issue between Digital and Intel.

The deal generated both pessimistic and optimistic comments. Pessimists warned that it's the end of the Alpha, as Digital will now support the IA-64. Optimists believe that Digital will now have more resources to accelerate Alpha designs for multiple foundries. "This agreement meets both companies' needs," says Craig Barrett, president and chief operating officer at Intel.

According to Syed Ali, executive director of Alpha marketing at Samsung Semiconductor, "Samsung is now poised to take the lead in Alpha manufacturing, on both the price and the performance fronts." He adds that Samsung is not alone in its long-term Alpha support, noting that "Mitsubishi will also offer current and future Alpha PC processors, and AMD will use the ultrafast 21264 Alpha bus for its K7." That could make possible future chip sets and mainboards that support both the K7 and the 21264 Alpha families, according to Ali.

However, if the Alpha is to survive the Merced attack and take a significant market share away from Intel, the CPU needs to not only be priced affordably but also widen its performance delta against future Intel products. Ali expects his company's Alpha chips to reach the 1-GHz level by the end of this year, providing performance of well over 60 SPECint95 and 90 SPECfp95. Looking at Intel's rough Merced performance road map, the 1-GHz 21264 should be faster than the initial Merced, which will appear a year or so later.

Aaron Bauch, Alpha technical marketing manager at Digital Semiconductor, says that the Intel deal enables Digital and other Alpha partners to accelerate the performance road map because they will be able to make use of new CMOS processes faster. For instance, the jump to the 0.18-micron process, which was originally slated for late 2000 or early 2001, is now due to take place in late 1999. This will enable both higher operating frequencies and better features sets.

Jesse Lipcon of Digital stated in his keynote speech at DECUS Anaheim 1997 that the schedule for 0.18-micron Alpha microprocessors has been accelerated by roughly a year (to late 1999, according to other sources). He said that this change in scheduling is a result of the recent Digital-Intel agreement.

Besides maximizing the performance of the EV-xx Alpha family and enabling it to offer twice the performance of Intel chips at a similar price, Samsung is also tuning several new-generation chip sets for specific PC, workstation, or server use. According to Ali, Samsung is also using its expertise with fine processes for next-generation memories to accelerate the Alpha's move to smaller processes and greater speeds. In addition, the 64-bit version of Windows NT 5.0, running on an Alpha as a 64-bit architecture, will give the Alpha a huge time-to-market edge over the Merced.

With foundries and partners gradually embarking on designing their own CPU derivatives, chip sets, and other support, the Alpha processor is now less dependent on Digital for both its technical and marketing development. Whether all this will make the Alpha a serious alternative to the IA-32 and IA-64 remains to be seen: The ball is now in the Alpha-powered alliance court.

–Nebojsa Novakovic

New-Generation x86 and Alpha Processors*

Processor	Time of introduction	Frequency range (MHz)	Process technology (microns)	Instruction/cycle peak	Architecture (bits)	Internal cache (KB)	External cache bus (bits)	Frequency range (MHz)	External memory bus (bits)	Frequency range (MHz)	SPECint95 range	SPECfp95 range
INTEL X86												
Pentium MMX	4Q'96	166–266	0.35	2	32	2×16	64	66	64	66	4->7	3->5
Pentium II	2Q'97	233–333	0.35	3 (OO)	32	2×16	64	116–166	64	66	9->13	7->9
Deschutes	2Q'98	350–450	0.25	3 (OO)	32	2×16	64	175–450	64	100	14->18	11->14
Katmai	1Q'99	400–500	0.25	3 (OO)	32	2×32	64	400–500	64	100+	17->21	16->20
Willamette	4Q'99	500–600+	0.18	5 (OO)	32	2×64	128	500–600+	128	100+	28+	26+
Merced	4Q'99	600+	0.18	N/A	64	N/A	128	N/A	128	N/A	50+	70+
DIGITAL ALPHA (ALSO SAMSUNG, MITSUBISHI)												
21164	1Q'96	400–600	0.35	4	64	2×8+96	128	133–200	128	66–133	12->19	18->29
21164PC	4Q'97	400–533	0.35	4	64	8+16	128	100–133	128	66–133	11->14	13->17
21164PC	2Q'98	600–800	0.25	4	64	16+32	128	300–400	128	66–266	17->23	21->29
21264	2Q'98	700–1000	0.25	4 (OO)	64	2×64	128	350–667	64	200–500	50->70	70->100
21264PC	4Q'98	600–900	0.25	4 (OO)	64	2×32	128	N/A	64	N/A	35->50	50->70
21364	4Q'99	1200+	0.18	N/A	64	N/A	N/A	N/A	N/A	N/A	140+	200+

*Road-map estimates according to independent sources.

Pentium MMX and Alpha 21164xx CPUs have shared external cache and memory paths.

For the sake of clarity, not all processor models and bus-speed combinations are included.

OO = out-of-order execution; N/A = information not available.

"I have absolutely no time to get into a rut"

Tom Uijldert, systems architect at CMG Telecom Products

"I have absolutely no time to get into a rut. To my utter amazement I discovered one day that I'd worked at the same place already for more than three years. And that at CMG, by the way. The reason was, I became involved in various internal projects in the area of mobile telecommunications, and it just got a little out of hand. In a positive sense, to be sure, because we've been so successful in this area that in a few years' time we grew from a ten-person project into a group of 130 people working on several projects. Naturally, this was partly attributable to the market itself: privatization, competition and the great boom of mobile telecommunications with the growth percentages from 40% to 60% a year. But to a large degree we owe this growth to our products. I'm really proud that we've developed systems which have set industry standards internationally. Real-time distributed systems, special concepts for high availability of systems,systems on mixed platform, etc. At present, I'm working on a product recently launched: VASP®, CMG's Value Added Services Platform. This system will enable our customers to be quick to offer new services to mobile telephone users. It could concern interactive voice response, mobile connections to the Internet or stock exchange information obtained by mobile phone. As an architect, you give shape to the structure of such a product and monitor its consistency. You think up and develop the best possible infrastructure. The nice thing about it is, you don't look at technical aspects alone, but also at such areas as purchasing, logistics, sales, the market and customers. That often results in heated yet animated discussions with colleagues. At CMG, they really put your experience with real-time systems to work, and your knowledge of telecom and datacom protocols. Knowledge in breadth and depth, that is. Only then can you cope with the continously arising, technical challenges. So there's no chance to get into a rut."

CMG Telecom Products develops and supplies advanced and successful products that meet the requirements of major players in the rapidly expanding, international telecommunications market. In more than 30 countries, CMG's products are operational in the areas of network security, mobile message traffic and interactive communications services. The challenges lie in the areas of high performance, high availability, high reliability, security, standardization (ETSI/ANSI) and connectivity.

For our telecom products, we are seeking professional software engineers all with Technical College/Technical University educations. They will have an above-average salary, extensive career opportunities, professional colleagues, and ample possibilities for further personal and professional development. And as a result: pleasure in their work. For more information, please contact Mr. Peter Boschman, Associate Director, ++31 (0)30 23 39 300 or ++31 (0)20 44 80 158 (private). Or send him your résumé: CMG Telecommunications & Utilities B.V., division Telecom Products, P.O. Box 8038, 3503 RA Utrecht, the Netherlands. Internet: http://www.cmg.nl

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Multicolored Faxes

A new software program brings exact color reproduction to faxes, printers, and scanners.

Does color faxing sound like a solution to an important business problem? If your answer is no, then you're probably not in the graphics, interior-design, or clothing-manufacturing business. "A calibrated color fax would save us both time and money," says Tim Voegele-Downing, a design consultant for the Gucci, Christian Dior, and Burberry fashion firms.

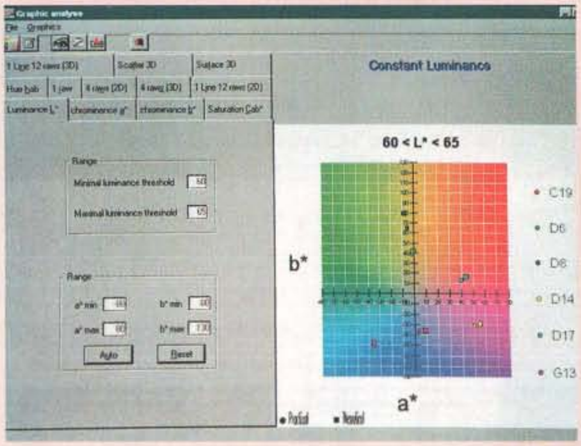
Faxing that offers the exact reproduction of colors regardless of the devices involved might come to market later this year, thanks to color-calibration software developed by the French company Couleur Communication Ecriture. CCE's AffixColor system provides a way of recalibrating color peripherals without using expensive colorimetric instruments.

The system maps the color values used by monitors, printers, scanners, and fax machines to and from the device-independent CIELab color space. CIELab, in contrast to computer and printing industry standards, such as RGB and CMYK, includes all the colors that the human eye can perceive and represents them as mixtures of the three primary colors.

AffixColor also includes a test suite that can display variations in colorimetric quality in 2-D or 3-D. It uses a color target or a CIELab reference file to analyze any color areas that might be reproduced badly. **–Dick Pountain**

Color Calibration

AffixColor allows you to calibrate your own color peripherals by using your scanner as a colorimeter. First you calibrate the scanner itself by scanning CCE's test target to create a scanner-calibration profile. You can have multiple profiles for different ambient conditions, such as temperature or time of day. Then you calibrate your printer by printing a CCE-supplied target file and scan the printed result to create a printer profile. You can recalibrate as often as needed and keep different profiles for different ink cartridges or paper stocks.



Minimal luminance threshold 60

Maximal luminance threshold 65

AffixColor controls the deviation of color reproduction of a printer and a reference.

It's also possible to create monitor profiles. Ideally, this requires the use of a spectrophotometer to measure the CIELab x and y values for red, green, blue, and white pixels. But you can also use the monitor manufacturer's x and y values or a visual comparison with a scanned CIELab color target.

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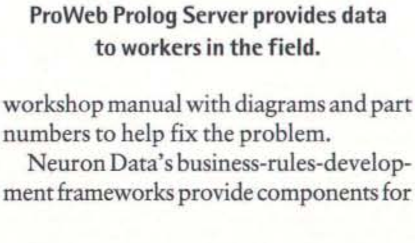
Harvesting the Fruits of AI Research

By applying rule- and case-based reasoning, induction trees, neural nets, and genetic algorithms, new optimization, filtering, and control software is now solving serious business problems.

Such applications include case-based reasoning tools from Acknosoft, Recall from ISoft, Neuron Data's rule-induction components, Logic Programming Associates' ProWeb Prolog Server, and Autonomy's Content Server i3, which is based on neural networks. Most of these programs have their roots in the AI research of the 1980s.

Acknosoft, for example, developed a diagnostic and fault-monitoring system called Cassiopée for Boeing's 737 airliners. A maintenance engineer can describe a problem to Cassiopée via a question-and-answer session and get back a list of the most similar previous cases and their solutions. Clicking on a case brings up a workshop manual with diagrams and part numbers to help fix the problem.


Travelling Salesman

Please select the towns you wish to visit ...

ProWeb Prolog Server provides data to workers in the field.

Neuron Data's business-rules-development frameworks provide components for creating and maintaining a rule base and distributing applications via messaging middleware. It has helped organizations such as American Express, Boeing, NASDAQ, and Walt Disney World to centralize all business policies and procedures into a single repository.

The popularity of the Web has added new impetus to classic pattern-recognition algorithms. There's an increasing need to sift intelligently through reams of random data. Autonomy's Agentware i3 uses linear adaptive filters, a neural-net variant, to learn Web site visitors' preferences and present them with news clips and links that match their interests.

Logic Programming Associates' ProWeb Prolog Server package contains a complete Prolog compiler that has the ability to run server-side Prolog programs to perform searches and manipulations on Web data. In one application, the system provides insurance quotes based on a user's answers to an HTML form. **–D. P.**

Smarter Smartcards

Better processor and memory technologies, open APIs, and new OSes pave the way for multiple applications running on one smartcard.

By Peter Hofland and Lana Janowski

Picture this: At a supermarket checkout counter, you pay for your merchandise with money stored on a small electronic card. To reload your electronic purse afterward, you plug the card into your Global System for Mobile Communications (GSM) phone and dial up your bank account. Then, on the metro, the same card gives you access to the train home because it holds your prepaid monthly ticket. Once you get home, the card identifies you as a subscriber of your favorite TV channel as you plug it into the set-top box.

ILLUSTRATION: BRIAN ZICK © 1998

Portions of this multifunctional smartcard scenario are reality today in, for example, Swedish Postgiro Bank's and GSM network operator Telia's remote banking application, in Dutch Postbank's and PTT Telecom's Chipper project, and in Singapore City University's and Hang Seng Bank's CitySmart program.

In about two years, however, smartcard technology will be mature enough to offer yet another level of convenience. At that time, you'll be able to decide what kind of ticketing, payment, and loyalty programs you want to have running on your card. All you'll need to do is get a so-called white card, or lifestyle card, and load the applications you want.

Rapid advances in the design and manufacture of components have driven the growth of the smartcard industry. Smartcard technology will mushroom into what analysts estimate will be a $16 billion market by the year 2005. "The smartcard industry's investments in research have led to improvements that, just a few years ago, no one would have dreamt about," says Russel McCullagh, a senior technical marketing manager with Motorola Semiconductors (Glasgow, U.K.).

But on the other hand, proprietary card OSes and incompatible standards are hampering the growth of the industry. To ensure the success of multiple applications on one card, interoperability is indispensable. Several standardization initiatives are addressing the interoperablility of cards, readers, and applications (see the text box "A Group of 'Standards'" on page 40IS 8).

Java's Pivotal Role

Not surprisingly, Java's multiplatform capabilities and inherent security features will play a pivotal role in the next generation of multifunctional cards. Through the Java Card API standard, this programming language entails shorter development and testing cycles because it relieves developers from the traditional chip-masking process, which can take up to four months. Because of its popularity in the developer community, Java is open to anyone who can develop applications using common development tools.

The Java Card 2.0 API includes an object-oriented programming model, which allows for the definition of classes, interfaces, and packages with dynamic and static fields and methods. "Thousands of Java developers have the opportunity to write high-level, object-oriented applications that run securely on smartcards," says Fabien Thiriet, Cyberflex product manager at Schlumberger Electronic Transactions (Montrouge, Cedex, France). Any smartcard that integrates with a Java Card 2.0–compatible virtual machine (VM) can run these applications, even if the microcontroller and card OSes are different. This concept enables multiple applications to run on one card.

"The ultimate opportunity for Java Cards lies in the possibility of cryptographically separating the card issuer from the application issuer," says Jelte van der Hoek of DigiCash (Amsterdam). Capitalizing on Java Card applets, called cardlets, consumers can use their white card and decide which cardlets they want to put on a card. Although application issuers might guarantee hassle-free and secure interoperation only with certified cards, the choice remains with the user.

Schlumberger's second-generation Java-based Cyberflex card can be dynamically added to or updated at any time. In this case, the white-card issuer provides the service of adding applications, but the user can download or update new services as well. Early Cyberflex adopters report that typical applications, such as single-sign-on password management and remote banking authentication, require between 1.5 and 2 KB of memory, making it possible to store up to three applications on a white card.

Due to the very limited resources of today's mostly 8-bit-processor cards, the Java Card API lacks some of Java's important features, such as unicode characters, floating-point numbers, double data types, exceptions, threads, and garbage control. The use of floating-point numbers alone requires about 2 KB of memory, which application writers today would rather use for mission-critical purposes.

Thus, the Java Card interface is no more than a smartcard-specific subset of the Java programming language. But new hardware improvements, due to arrive on the market in the next 18 to 24 months, will enable 32- and even 64-bit data types, making Java Cards viable multifunctional systems.

32-bit Processor Cores

Traditional smartcard microprocessors typically use the Motorola 6805 or Intel 8051 instruction set, which allows them to address 64 KB of 8-bit memory. But because of the cost constraints of large applications and the limitations of the microcontrollers' plastic housing, most applications in use today offer only up to 20 KB of memory. But better cryptography and more sophisticated OSes and VMs require more memory resources and the ability to perform real-time operations.

In an attempt to solve this problem, Gemplus's GemXpresso Java Card uses an implementation of ARM's 32-bit RISC ARM7 processor. This processor not only provides for 32-bit computations but also offers 20 MIPS of computing power, which can allow applications to run up to 60 times faster than on existing 8-bit processor cards. "This extra computing power is definitely an advantage in the context of Java," explains Arnaud Chain, multimedia marketing director at Gemplus

A Group of "Standards"

Several years ago, in an attempt to promote smartcard interoperability, the ISO developed the 7816 standard. It focuses on a smartcard's size, weight, and electrical and data-link-protocol levels. Later industry standards, such as the Global System for Mobile Communications (GSM) and Europay, MasterCard, and Visa (EMV), adopted the ISO standard and defined their own application-specific data and encoding rules. Application-interoperability issues, such as cross-industry standard interface and command set, were not addressed in these later standards.

Building on these existing standards, the PC and Smart Card (PS/SC) Workgroup, whose members include Bull CP8 Transac, Gemplus, Hewlett-Packard, Microsoft, Schlumberger, Siemens Nixdorf, and Sun Microsystems, two years ago began addressing the interoperability between PCs and smartcards. The result is a standard interface and a set of command-set specifications for platform-independent and application-neutral solutions for hardware and software developers alike.

The PS/SC specification allows for interoperability between cards and readers from different manufacturers. It also reduces software-development costs by making resource sharing across multiple applications possible.

Microsoft's announcement that Windows 98 and NT 5.0 will include a PC/SC-based API and interoperate with smartcard hardware solutions at the device-driver level is a strong indication that PC/SC will gain broad acceptance in the industry.

Java Card 2.0, an API supported by a consortium of smartcard manufacturers, was specified by JavaSoft. Java Card applications run on top of a Java virtual machine (VM) that, to a large extent, shields the card's OS details from the application.

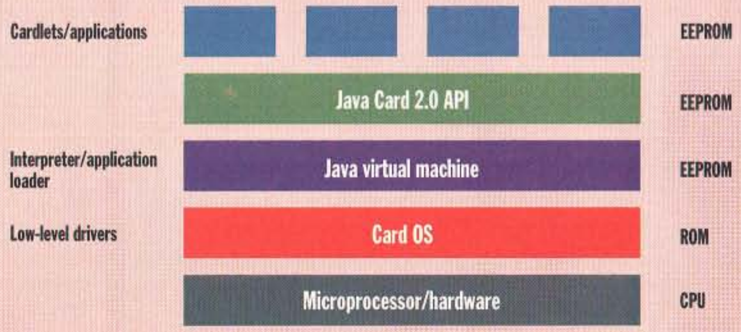
The fundamental strength of the Java Card 2.0 API is that it offers both security and integrity. By making use of Java's security features, each application occupies its own allocated memory space, thus avoiding interference between applications. With a card issuer's authorization, it's possible to securely add and remove applications on a single card.

The OpenCard Framework, which is supported by companies such as IBM, Netscape, Oracle, and Sun, originally aimed at introducing smartcard standards into the network-computer (NC) arena. Sun says it will incorporate OpenCard into its network-management and NC strategies as a complement to Java Card. In addition, the recent work of the OpenCard group aims at an interoperation with the PC/SC specification.

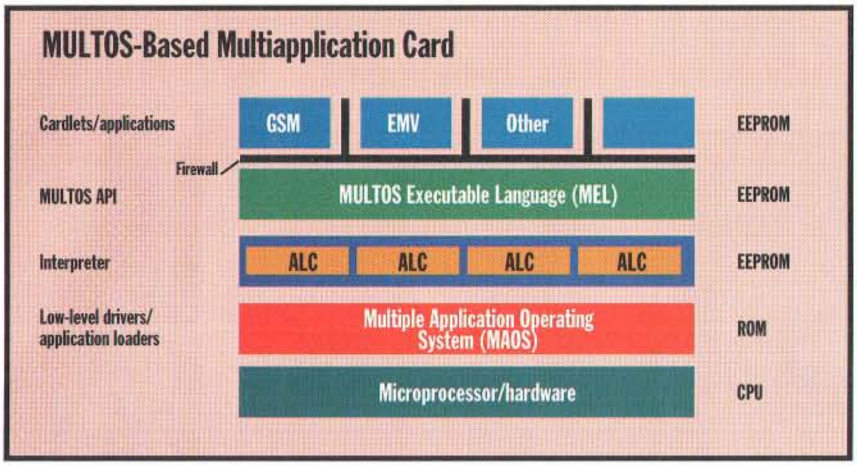
MULTOS, a multiapplication-card OS, enables a number of different products or services to be held securely and independently on a single card. It builds on the ISO 7816, EMV, and GSM standards, so products from different industries can coexist on the same card.

MULTOS and the Java Card API share the same goal, but they cannot coexist on one card. Only one interpreter can be in control of application execution at any one time. However, Sun and Mondex International are working on interoperability specifications for both platforms. In the end, Java Card and MULTOS might make it possible for developers to sell truly hardware-independent applications.

Java Multiapplication Card



Applications are segregated into their own memory space.


MULTOS-Based Multiapplication Card
Cardlets/applications
GSM
EMV
Other
EEPROM
Firewall
MULTOS API
MULTOS Executable Language (MEL)
EEPROM
Interpreter
ALC
ALC
ALC
ALC
EEPROM
Low-level drivers/ application loaders
Multiple Application Operating System (MAOS)
ROM
Microprocessor/hardware
CPU

MULTOS is compatible with most international standards so that different applications can coexist.

(Gémenos, Cedex, France). "Dealing with high-level objects requires a lot more resources than directly addressing low-level functions on the card." The new ARM processor, for example, allows application developers to deal directly with 32-bit integers, which is a lot easier than cutting 32 bits into many 8-bit parts.

In addition, GemXpresso rapid application development (RAD) tools offer advanced memory management and a partial garbage-collection algorithm to increase programming flexibility. These features allow for Java stacks up to 1 KB, thus eliminating a severe constraint of the Java Card platform.

Patrice Peyret, director of the Smart Card group at JavaSoft, believes that the introduction of these 32-bit processor cards will accelerate the creation of new applications. "The combination of more-powerful hardware and Java Card's advanced software architecture will allow the speedy development of more advanced smartcard applications," she says.

Faster Memory

The industry's current move to replace EEPROM memory technology with ferroelectric RAM (FeRAM) will further propel the efficiency of smartcards. Companies such as Motorola and Matsushita have been working on the development of FeRAM for five years. Now several manufacturers are furnishing their next-generation cards with this technology. The first FeRAM-based cards will become commercially available by the end of 1999.

FeRAM is a nonvolatile technique that speeds memory access to as much as 20 times faster than EEPROM technology. Also, FeRAM-based smartcards offer a significant increase of memory capacities—up to 128 KB. These features—coupled with very low power consumption, greater endurance, and a cell programming method ideally suited for large memory arrays—make FeRAM an attractive alternative for smartcard manufacturers.

This increase in computing power and memory, as well as the use of a high-level programming language, will allow the processing of more complex mathematical functions, which is simply not possible with 8-bit processor cores. However, the extra MIPS will also help smartcard manufacturers capitalize on advances in biometrics and cryptography. This, in turn, might allow the creation of single-application banking, GSM, and health-insurance cards.

But there are questions concerning the uptake of multiapplication cards. "The current growth of the market is predominantly driven by closed systems, single applications, and national programs," says McCullagh. "The key to a real market expansion is an open software scenario, and this requires true multiapplication standards, much like in the PC world."

Adds DigiCash's van der Hoek: "With the current Java Card standard release, there's still the problem of loading the smartcard. The issuer must still create a download instruction for an application on a specific card." This defeats the purpose of standardizing on a common API, because if card issuers have to be involved before an application can be added, then the card might as well be programmed in a manufacturer-specific language.

As a result, this limits a consumer's freedom to mix and match applications and cards. "Only when Java Card applets can be downloaded with public-key technology and when processing inside the card is publicly verifiable by consumer organizations will the real power of Java surface," says van der Hoek.

A Not-So-Open Standard

The potential problems of a not-so-open Java Card standard might be avoided by vertical-market solutions. The Java Card Forum is now working on Vertical Market Extensions for banking and telecommunications. For example, cards issued by banks might come with additional subsidiary applications that allow consumers to tailor cards to their needs. A multiapplication card issued by, say, a health-care organization piggybacking an insurance program and a government agency's identification application would no doubt be a useful product.

Tom Lebsack, director of marketing and business development at Schlumberger's Austin Product Center, says that "it's just logical that issuers control cards." According to the Java Card Forum, such multiapplication cards are close to a commercial introduction.

Today's applications are specifically tied to the card OS (COS) of a particular card, which in turn is usually tied to a specific chip. Most existing COSes allow only one application per card. Last May, however, eight of the leading card manufacturing and issuing companies, including Gemplus, Hitachi, Mastercard International, Mondex International, Motorola, and Siemens, announced a new open multiapplication COS, called MULTOS. Although MULTOS is not the only multiapplication COS, it has the widest industry support today.

MULTOS enables a number of different products or services to be held securely and independently on a single card. Because MULTOS is compatible with most international standards, such as ISO 7816, GSM, and EMV (short for Europay, MasterCard, and Visa), products from different industries can coexist on the same card. MULTOS makes it possible, for example, to combine subscriber identification data for GSM phones with EMV credit or debit products and an airline's frequent-flyer scheme.

To securely download or delete applications, MULTOS uses Application Load Certificates (ALCs) and Application Delete Certificates (ADCs), which are specific to cards and applications. By using ALCs, MULTOS verifies that an application was initiated correctly after download. It checks the validity and integrity of the application, allocates a protected and isolated memory area, and locks the new program into this secure space. This way, applications are strictly separated from each other so they cannot interfere with one another.

Due to MULTOS's security architecture, card users can customize their cards and download new services via phone or the Internet. This architecture also lets card issuers add applications and introduce security upgrades without discommoding their customers. Applications on the card are kept separate by secure firewalls, allowing for only the selective disclosure of private (but not secret) information.

This identification-verification scheme allows the operation of only authorized applications and ensures that applications have access only to their specific information base. It also guarantees the security and integrity of each application.

MULTOS includes the MULTOS Executable Language (MEL) and an API that developers can, for example, access from the C programming language. This, together with the COS's interpreter concept, might enable developers to sell hardware-independent applications. In addition, because of MULTOS's wide industry support, it might eventually become a standard for issuers operating in the finance, retail, media, and telecommunications sectors.

Although MULTOS and the Java Card API share the same goal of an open industry platform, they are not 100 percent compatible. Therefore, they are competing models. Today it seems that, for security reasons, developers must choose one or the other because MULTOS and Java interpreters cannot coexist. Only one interpreter at a time can be in control of application execution.

But Sun Microsystems and Mondex have already announced that they are working on a Java Card 2.0 API for MULTOS, which would allow Java or MEL to act as a primary application-development language. Java Card–based applications would then be able to run on Java's VM on top of MULTOS. Says Lebsack: "We believe that Java, in combination with an open, multiapplication OS, is where the industry should go." **B**

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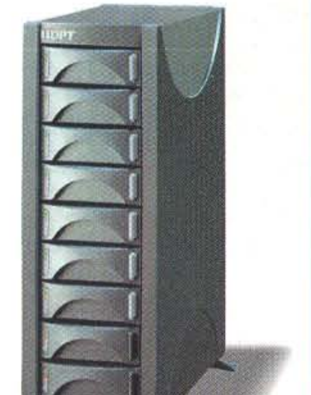

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I_2O's Promise

For certain enterprise applications, the new breed of I_2O servers will compete favorably with Unix-based servers—and at a much lower price.

By Stella Kao

Windows NT servers are rapidly achieving new levels of scalability. Dual-processor and four-way symmetric multiprocessing (SMP) servers are now common. And with improvements in Intel's microprocessors and new I/O architecture, performance has improved dramatically at significantly lower costs.

Aiming at the high-end application-server arena, which was once exclusively dominated by Unix servers, new Intel-based servers now support full redundancy and manageability. Features such as hot-swappable power supplies, redundant cooling fans, voluminous hard disk expansion chassis, and massive memory support are all enabling these systems to provide performance similar to that of departmental servers, but at prices closer to those of desktop PCs.

"It's hoped that all these efforts will push NT systems deeper into corporate enterprise networks," says Tony Chen, director of the PC department at Amaquest Computer (Taipei, Taiwan).

Although server-class processors developed by Intel offer more speed, overall system performance is still hampered by I/O bottlenecks because these chips are not specifically geared for handling device interrupts. I/O interrupts occur at a server when a communication request is issued by, say, a client/server transaction application. Depending on how the I/O device is implemented, it can interrupt the CPU once or many times during a single I/O operation.

ILLUSTRATION: BRIAN ZICK © 1998

The I_2O architecture, due to its ability to diminish these network bottlenecks, is viewed as a key technology for boosting the performance of PC servers. With I_2O, interrupt-intensive I/O processing is off-loaded from the host/server processor onto I/O devices, allowing the host CPU to concentrate on its primary job, data retrieval. Vendors say that high-speed I/O performance is important for a growing class of I/O-intensive applications, such as video, groupware, and large databases.

In addition, I_2O puts an intelligent device between a peripheral and the OS. Therefore, peripheral vendors need to write only one driver to the I_2O standard; the OS then communicates with the I_2O subsystem.

Network servers that support both the Intel 960 RISC chip and the I_2O architecture are expected to appear in volume this year. Many server vendors, including those from Taiwan, began showing their first full system implementations of the I_2O architecture at Comdex in November. During that show, three Taiwan companies—Acer, Amaquest, and Tatung—unveiled I_2O-compliant systems, and Asustek Computer demonstrated its I_2O server motherboard. "I_2O will give Intel and Microsoft their first real shot at competing head-to-head with Unix servers," says Chen.

Hardware integration is not the only factor that's important to the success of I_2O; full support from Windows NT is a bigger issue, according to Cliff Chou, director of the networking systems business unit at Acer. "Giving the OS the ability to take advantage of it is the real challenge," he explains. "NT isn't there yet." Microsoft isn't expected to offer full I_2O support until Windows NT 5.0 ships sometime this year, Chou adds.

Currently, Microsoft offers I_2O support for Windows NT 4.0 in the form of a Service Pack. Several server vendors in Taiwan have been working with an early version of I_2O running on NT 4.0 since late 1997. In addition, Novell, together with IntranetWare, endorses the I_2O standard and NetWare 4.11, which should be available early this year. Novell has also promised to build I_2O support into its next server OS. SCO's Gemini NetWare supports the Intel architecture as well.

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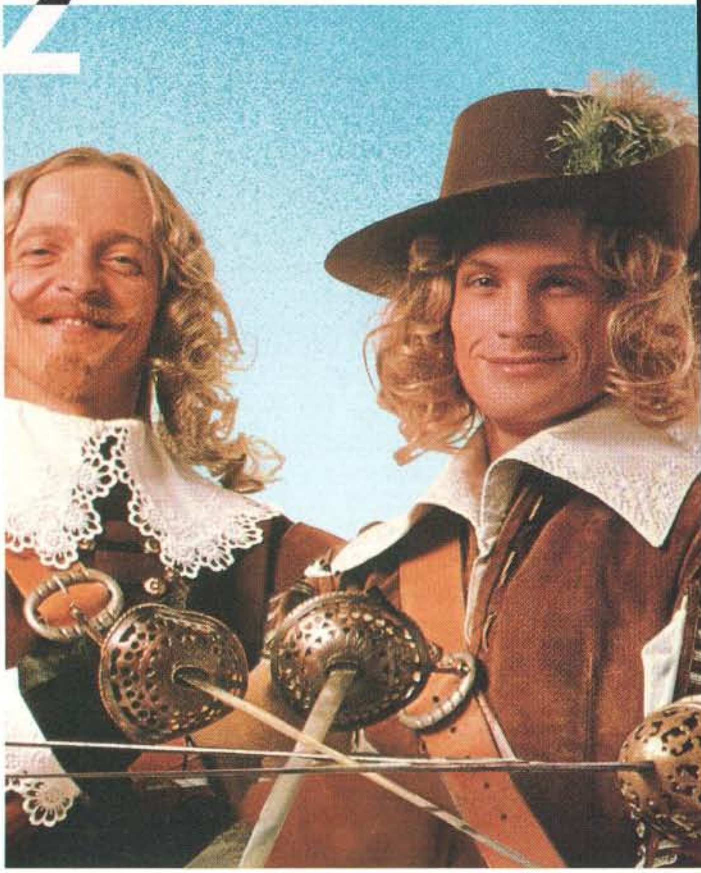

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The big question, of course, is: How much of a performance gain can users expect? The short answer is that it depends on the application, but I/O-intensive databases could see performance gains of 60 percent or more, according to server vendors. Testing is done by server makers to see how much of the I/O work load the i960 processor can handle.

Ideally, the new I/O architecture will significantly improve overall performance by having the i960 processor be responsible for all the I/O processing. But the initial rollout of the technology is not likely to achieve that goal, according to Jerry Lee, Asustek's associate vice president for product marketing and technical support. Some benchmarks show an improvement of around 10 percent to 15 percent.

Fault-Tolerant Designs

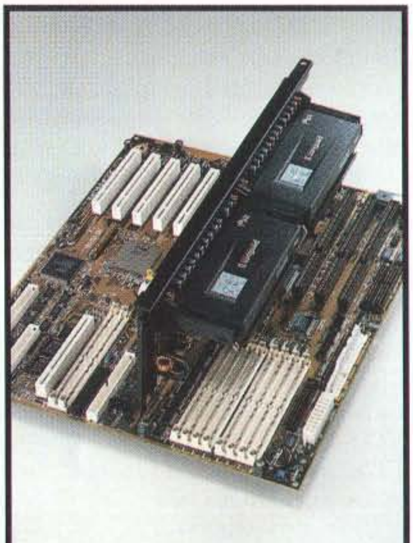
PC server vendors are responding to user demand by moving some degree of fault tolerance into their low-end and midrange systems. A host of new NT servers now includes error-correction-code (ECC) memory and an optional RAID controller, both of which are unusual in entry-level systems.

Chen says that servers are now being used more in distributed environments, where more fault-tolerance features are required. Downtime costs, coupled with data loss, are just too pricey for small-to-medium-size businesses. Equipped with RAID and "hot plug" technology, fault-tolerant servers can continue operating if any of their processors or other parts fail. Users can simply swap out the drives, power supplies, fans, and other parts while the server is still working.

Another quality that makes these Intel servers suited to client/server applications is their use of the Highly Parallel System Architecture (HPSA), which enables computer makers to incorporate two independent PCI "buses"—one of which is then bridged to an EISA bus for support of older peripherals—to eliminate data bottlenecks between peripherals, such as hard drives and the system's memory and processor. Hence, these systems include at least five—and up to eight—PCI slots.

Many servers devote a significant portion of their resources to the maintenance of high availability in their disk arrays. Most servers now come with two separate SCSI processors, a mirrored cache, battery backup, and a redundant power plant. This approach eliminates most single points of failure in the disk channel. In addition, Acer, Asustek, and Tatung have all included in their server solutions environment-monitoring sensors that monitor temperature, voltage, and fan speed; prevent crashes; and detect intrusion.

Asustek's P/I-P65UP8 motherboard, for example, provides server manufacturers with seven PCI slots, as well as Symbios 53C876 and AHA-7880 PCI Ultra Wide SCSI controllers, plus the hardware required to implement I_2O functions. The Asus SMP server motherboard will be targeted at Internet/intranet applications and database-server markets. Asustek offers a wide selection of CPU daughterboards that contain one or two Pentium Pro or Pentium II processors. A quad-processor daughterboard will be available by June. Other features of the Asus server motherboard will include as much as 1 GB of extended data out (EDO) DRAM, ECC memory for reliability and data security, and redundant hot-swappable power supplies.

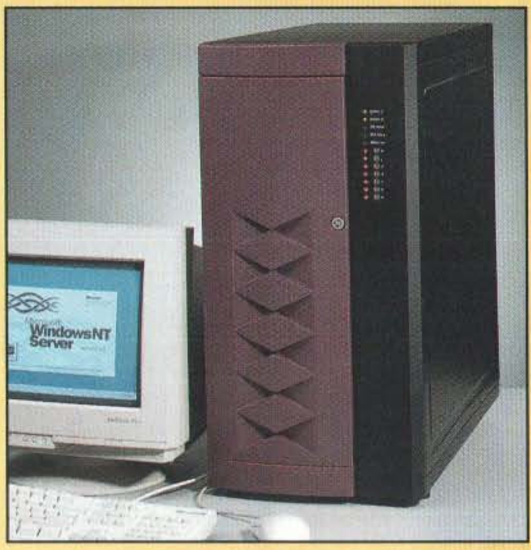


Asustek's P/I-P65UP8. The company offers many CPU daughterboards.

Unix Servers Under Attack

While the first microprocessor to implement Intel's IA-64 architecture probably won't appear until 1999, industry analysts are already predicting that IA-64 processors will take over most of the market that workstations from, for example, Silicon Graphics, now fill. Today, the rise of the Pentium Pro microprocessor and the Windows NT OS has threatened the existing market position of Unix-based servers from vendors such as IBM, Silicon Graphics, and Sun Microsystems. In fact, Wintel servers are increasingly capturing the midrange-server market.

Although today's Intel machines can hardly attain the high-end performance of Unix machines, they're grabbing a good slice of the low-end and midrange market because they're considerably less expensive. Major Unix vendors are scrambling to announce plans to follow Intel's lead. For example, Hewlett-Packard is moving from PA-RISC to IA-64, and Silicon Graphics recently acknowledged that it will add Intel-based systems to its lineup. In addition, Sun has already made moves to align itself with the Intel camp, and it has announced that Solaris will fully support Intel's next-generation Merced chip.



Amaquest's FT-830 clustering server.

But this doesn't mean that Unix vendors are rolling over and playing dead. They're introducing high-performance clustered enterprise systems. For example, Sun will increase cluster support from two nodes to four with its Full Moon technology. This will enable users to cluster four 64-processor Ultra-Enterprise 10000 symmetric multiprocessing (SMP) servers, for a total of 256 processors. Meanwhile, IBM and Digital Equipment are adding 64-bit SMP machines to their product lines. "I'm sure Unix workstations will continue to dominate the high end of the workstation market," says J. L. Tasy, general manager for the international RISC system division at Tatung. "For transaction-intensive applications, Unix systems are still the best choice," adds Tony Chen of Amaquest. His company has picked Digital's Alpha processors as the base technology for its new-generation servers.

Amaquest is also currently working with Digital to introduce a clustering server based on Digital's 600-MHz 21264 processor. This high-speed chip offers a peak execution rate of 2.4 billion instructions per second and boasts 18.0-SPECint95 and 27.0-SPECfp95 ratings. This new Alpha server will include dual 21264 CPUs, an Intel 960 chip, and Windows NT. The server is due early this year, according to the company.

Remote management is an essential component of a workgroup server. A good management program lets an IS manager monitor server status from a remote office. Intel's LANDesk, which is included with many workgroup servers, is a powerful utility that monitors a server's vital signs, such as the power supply's output voltages and the temperature inside the chassis. Some companies also offer proprietary vendor-developed solutions, such as the AcerAltos 9100 Advanced Server Manager (ASM) Pro and Remote Diagnostics Manager, and Amaquest's SNMP remote-control software.

True Clustering

Clustering is a technology for connecting separate computers, each running its own copy of an OS. For example, two separate four-processor Pentium Pro servers, each running its own copy of NT, can be connected to form a cluster. Currently, clustering is used primarily for high-availability and failure purposes, so vendors can offer a degree of fault tolerance in Pentium Pro servers.

Clustering essentially creates a quick-response, intelligent backup system in case one of the servers, or one of its components, fails. As a result, users are subjected to far fewer network outages. Until recently, clustering has generally been available only as a proprietary technology on Unix platforms.

Microsoft's Server Cluster server brings this technology to the growing NT server market by providing computer vendors, resellers, and IT managers with the means to tie systems together in a fail-safe bond. Late last year, Microsoft released Windows NT Server 4.0 Enterprise Edition, which includes Cluster Server (MSCS).

Previously code-named Wolfpack, MSCS is a part of the set of APIs currently being developed to turn Windows NT Server and the BackOffice suite of applications into a clustering platform. Microsoft has said that a two-node variant, which will address failover fault tolerance, will be the first to arrive. Still another form of clustering at a higher level is currently being explored by Microsoft.

One of the first clustering servers to be developed in Taiwan is Amaquest's VPro "Cluster-in-a-Box" system. The server includes two separate 200-MHz Pentium Pro or 233-/266-MHz Pentium II system boards connected via 10-/100-Mbps Ethernet. The Ultra Wide SCSI controllers are configured as an independent bus, with each system's SCSI bus terminating at the storage processor in the disk subsystem.

The VPro system can run in shared-bus mode. Each system can function independently of the other and can run all standard NT applications. This configuration provides service to one clustered system's connection without interruption to the other clustered system and prevents a total failure if a SCSI cable comes off and breaks the SCSI bus.

Amaquest plans to introduce four-way servers that use the Intel 440NX chip set. By the second quarter of this year, the company also plans to offer a new clustering server that contains three nodes in a box running Windows NT 5.0. **B**

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Intel's IA-64 Architecture

Today's departmental and enterprise servers are mostly based on RISC technologies developed by Hewlett-Packard, IBM Microelectronics, and Sun Microelectronics. With a total of between six and eight execution units on a chip, RISC processors offer superior performance. This speedy performance enables the development of solutions such as multiple integer-execution pipes, multiple floating-point pipes, and separate load/store and branch hardware.

In contrast, Intel is forging an innovative path toward explicit parallelism with its new IA-64 architecture, which relies on a new kind of cooperation between hardware and compiler. IA-64's most notable characteristic is its massive complement of registers: There are 128 integer, 128 floating-point, and 64 new speculative registers for the compiler to work with. This aids performance by obviating the need for the compiler to perform bulky register-renaming tasks.

Another important feature of IA-64 is its very long instruction word (VLIW) architecture. A packed instruction word, which is 128 bits wide, incorporates three separate instructions and maps them to functional units in the target processor. A template field specifies dependencies between the instructions and other packed words.

Intel's next-generation 64-bit Merced processor is part of the IA-64 line developed by Intel and technology partner HP. As a hybrid of Intel's x86 technology and HP's PA-RISC chip, Merced will combine the benefits of RISC and CISC to offer Explicitly Parallel Instruction Computing (EPIC). With EPIC, instead of generating machine instructions sequentially and then letting the processor decide how to execute them, the compiler produces code already written in parallel. The parallelized instructions allow the chip to process a number of instructions simultaneously, theoretically making IA-64 chips more efficient.

The 64-bit chips, due in 1999, will also read the 32-bit code that's used by the current generation of Intel processors, which will make them backward compatible. That promises far better 32-bit performance than can be obtained using the alternative, software translation.

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Better Control with PDM

Product data management is most efficient when it's combined with enterprise-wide applications.

By Adele Hars

Manufacturing companies are usually good at recording component and assembly drawings; it is, after all, part of their daily business. However, they often fail to keep comprehensive records of related product data. This makes it difficult—and often impossible—for product designers and engineers to access pertinent information when they need it. It's estimated that in the manufacturing industry 50 percent of product-development time is spent tracking down information, maintaining multiple revisions of design studies, and checking relationships among 2-D drawings, 3-D solid models, assembly instructions, and process plans.

This is where product data management (PDM) comes in. PDM aims at bridging the gap between product and design data, typically through a relational database system. It also provides procedural control of product data by facilitating approvals and notifying team members of a project's status. In other words, it supports project coordination and allows companies to implement concurrent engineering schemes and compress the product-development cycle.

For example, a PDM system permits a project leader to control the progress of a project via "states" using "triggers" and a routing list that reflects a company's organizational hierarchy. Or, to coordinate a particular work flow effectively, a worker can define the interdependence of tasks to match a project's structure, time frame, and goals.

"PDM helps engineers manage both data and the product-development process," explains Ed Miller, president of CIMdata (Godalming, Surrey, U.K.), an international PDM consultancy. "However, it's not designed to help individuals do a better job, but rather to facilitate an organization's management initiatives." Such initiatives might include concurrent engineering or conforming to the "design anywhere, build anywhere" philosophy.

An organization moves to PDM primarily because such a system can help cut the time it takes to bring a product to market. But PDM is not restricted to the manufacturing industry. Its ability to manage a vast amount of different data types benefits other industries as well. For instance, 20 percent of the installations of Hewlett-Packard's WorkManager PDM system are in the health-care, insurance, construction, telecommunications, and software-development industries, according to Dietmar Jenuwein, a member of HP's German PDM marketing group.

As a concept, PDM has been around for more than a decade. Early PDM systems were not successful primarily because they were not flexible enough to handle the uncontrolled proliferation of data within an organization. But as consistent data modeling becomes more prevalent throughout the entire development process, PDM stands a good chance of delivering on its promises.

Today an increasing number of companies are installing PDM systems. The global PDM market, which is currently worth over $900 million, expanded by 31 percent in 1996, according to CIMdata. The company expects a total market volume of $2 billion by the year 2000. CIMdata also says that Europe accounts for just over a third of this volume and that the European market is faster-growing than, for example, the U.S. market.

Results from the most recent survey issued by the British Department of Trade and Industry (DTI) reveal that PDM users experience several important benefits from using these systems. These include a 10 percent reduction in engineering costs, a 20 percent decrease in product-development time, 30 percent faster reactions to changed orders, 40 percent fewer changes in the development process, and, in combination with concurrent engi-

ILLUSTRATION: BRIAN ZICK © 1998

neering methods, a time-to-market decrease up to 50 percent.

"Considering only our increase in engineering productivity and our reduction in costs related to quality defects, we've had a 14-month return on our investment," says Philippe Martin, IS director at Schlumberger (Paris, France), which implemented an enterprise-wide PDM system in 1996.

Many previous generations of PDM were based on relational database systems. Now that PDM applications include more object-oriented features, systems are a lot easier to manage. As Mark Horne, general manager of Quillion Systems, a PDM vendor in the U.K., notes, "Object technology is the only way to efficiently manage product data, although you still have to comply with the relational-database world."

With object orientation now being used, the type of data used for a PDM application no longer matters. A CAD drawing, process information, bills of materials, and an engineering-change order can all be different kind of objects and still used in the same system. In addition, objects support dynamic data, which facilitates rule-based process flows.

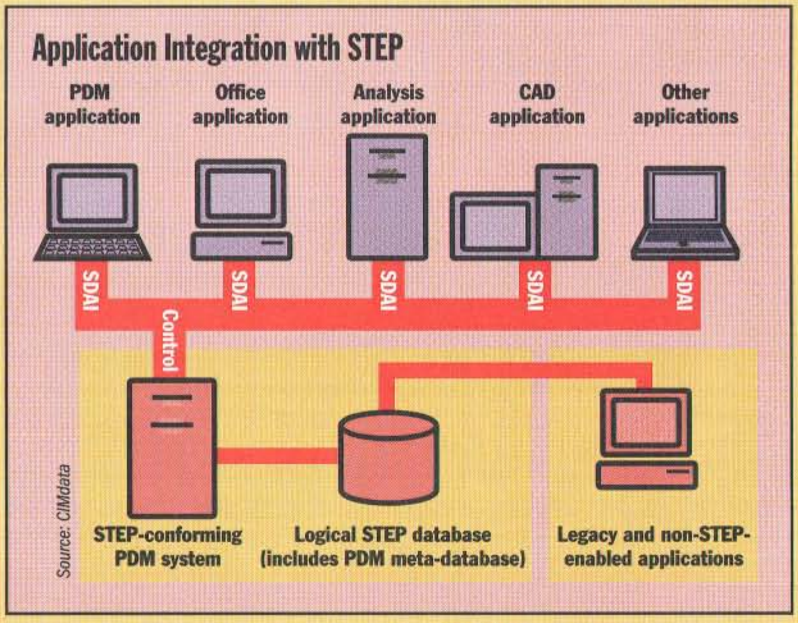
STEP and Product Data Management

Data exchange and data sharing between different PDM systems can be efficient only if both systems support the same data model or their data models have the same level of richness. The ISO's Standard for the Exchange of Product data (STEP) aims at providing methods for storing and exchanging product configurations, bills of materials, engineering-change orders, and organizational and personnel data throughout the product-development cycle.

An important and difficult area in PDM is the interaction between a PDM system and the applications that create and change product data. STEP addresses this issue with a data-management layer between applications and the STEP repository. This approach offers two key advantages: Data is independent of the application that generates it, and applications that use STEP's Standard Data Access Interface (SDAI) can communicate with all other compatible applications. In addition, a universal data-management layer reduces storage space because only one version of an entity needs to be stored.

Large industrial projects in the aerospace, automotive, and energy sectors are increasingly demanding STEP-compatible applications. Says Patrick Piekolek, Matra Datavision's PDM product manager, "We chose STEP because it lets us communicate with, for example, manufacturing-resource-planning systems."

Although STEP's consistent data model offers some obvious advantages, critics argue that it's still not in place today. They see the current ISO draft, AP 214, as an outgrowth of the European and Toyota automobile initiative. Crucial subsets of the standard, such as those for product structuring, versioning, and parts ownership, are not fully defined yet. "STEP is not ready. The data model is changing almost daily," says Norbert Reimann, director of SDRC's PDM business unit for central Europe.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Source: CIMdata

The Standard Data Access Interface (SDAI) enables PDM systems to communicate with other enterprise applications.

European Variations

But even though object technology is heralded as one of the big liberators of PDM systems, some conceptual problems between engineers and process managers remain. For instance, engineers tend to prefer straightforward working practices and do not appreciate the formal object definitions of PDM systems, according to Patrick Piekolek, product manager for Matra Datavision's Design Manager, an object-based PDM system.

Most of the big players in the PDM market, including CoCreate Software (a subsidiary of HP), Computervision, Dassault/IBM, Metaphase, Parametric Technology Corp. (PTC), SDRC, and Sherpa, are focusing on enterprise-wide installations in international companies. This leaves a big opportunity for local PDM vendors to address the data-management needs of engineering departments. To the extent that the industrial structure in Europe varies from one country to another, there are also substantially different local requirements for data management. In Germany, for example, the national DIN standards closely dictate design and manufacturing conditions—and therefore, for example, component-classification schemes. PDM systems have to reflect these local standards.

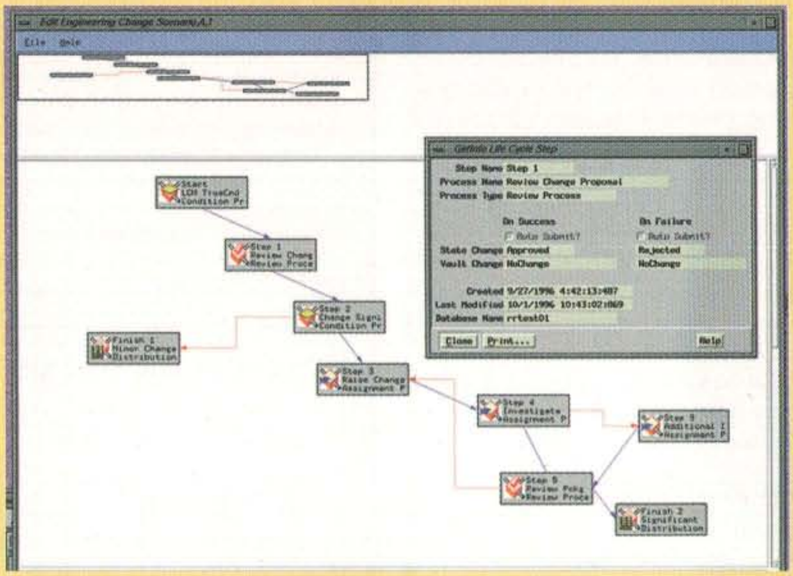
Today, one of the most important issues facing a PDM system is its ability to work with an enterprise-resource-planning (ERP) system and enterprise-management applications, such as SAP's R/3 and Baan's Triton. "In two years, you won't find any reasonable system without an SAP or Baan interface," says David Hodgson, general manager for AIM Systems, a PDM system vendor in Karlsfeld, Germany.

For example, Matra Datavision's new Euclid Design Manager for Windows NT connects to enterprise-management systems from SAP and Baan via an interface based on the ISO's Standard for the Ex-

Installing a PDM System

Implementing a PDM system in a large, international company requires an enormous amount of planning and reengineering of business processes. "You really need to look at the corporate work flow and optimize it. It's no good just to apply PDM to old, bad flows," explains SDRC's Norbert Reimann.

To make implementation easier, PDM vendors are providing streamlining options. For example, SDRC is introducing templates to standardize process implementation in specific industries, as well as encouraging other PDM vendors to adopt these templates for regional and industry-specific needs. For the same reason, PDM vendor Sherpa has developed industry-specific object libraries so that new users needn't start from scratch. This avoids each company's having to define objects, processes, and data relationships when there are often many similarities between processes within an industry.



Step Name Step 1
Process Name Review Change Proposal
Process Type Review Process

	On Success	On Failure
	☐ Auto Submit?	☐ Auto Submit?
State Change	Approved	Rejected
Vault Change	NoChange	NoChange

Created 9/27/1996 4:42:13:487
Last Modified 10/1/1996 10:43:02:869
Database Name rrtest01

PDM helps to manage data as well as control the engineering process.

change of Product data (STEP). Other companies, such as Computervision, Dassault/IBM, and PTC, are currently extending their PDM products with enterprise-management functionality. On the other hand, the next version of SAP's R/3, 4.0, which is slated for release early this year, is expected to offer enhanced PDM functionality.

The lines between departmental PDM systems and higher-level business-management and enterprise-wide resource-planning systems are blurring. "There's already considerable overlap between PDM systems and business-management applications," explains Tobias Diepold, a project manager and PDM expert with IDS Professor Scheer (Saarbrücken, Germany). "When companies have both types of systems in place, they typically have to decide which one is to be the master and which will work as slave."

Diepold says that standardized interfaces between systems solve only part of the problem. Other points of friction between a PDM system and a business-management system include the management of engineering changes and the modification of processes within a running, complex engineering project.

PDM/Web Integration

As with everything else that it has touched, the Internet has brought big changes to PDM as well. "Web technology has had a terrific impact on this industry," enthuses CIMdata's Ed Miller. "With an intranet in place, you can get a lot of information in return for a small investment."

For example, CoCreate's Dynamic Conferencing modules for the WorkManager PDM system enable virtual 3-D modeling over the Internet. Design sessions can be shared across the Web, and users can discuss changes or make annotations to a model that was just designed in another location.

PTC's new Pro/Intralink product also includes tools for communications in a concurrent engineering environment, as well as an open architecture that permits information in the system to be shared or posted on the Web. "Information from various systems is being linked together in a common user interface: the Web browser," explains Tom Sears, PTC's director of data management.

PDM began as an aid to help engineers manage information, handle technical drawings, design models, and control the work flow in their departments. But the same technology that saves time and improves communications in engineering departments is now being applied more broadly to extend these benefits throughout entire organizations. Says Dick Arnold, a technical director at Hollandse Signaalapparaten, part of the multinational Thomson-CSF company: "PDM is key to staying competitive." B

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fax: +33 1 40 99 68 05
http://www.dsweb.com

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fax: +33 1 64 46 02 13
p-piekolek@paris1.matra-dtv.fr
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INTERNATIONAL

What's New

Hardware

A robot that can handle the e-mail deluge, a hardware firewall that protects your hard disk from viruses, plus other new tools.

PREVIEW

Hardwall
£150

Enter HotBYTEs No. 1032.

Calluna Technology
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fax: +44 1592 630920
rjs@hardwall.demon.co.uk

Protect Your Hard Drive

Do you trust today's operating systems and firewalls to securely shield the data on your computer from hacking attacks and viruses? As recent incidents show, software is vulnerable to bugs that compromise security. That's why Calluna developed a "hardware firewall" that monitors all low-level hard disk activities and protects against illegal disk writes and accesses.

Called Hardwall, the card plugs into an ISA slot and operates separately from the system processor. It sets up firewalls at the boundaries of every partition on your hard disk and lets you define different levels of access. Because these firewalls operate separately on a low physical level controlled by Hardwall, the vendor says, they are impossible to penetrate and cannot be circumvented.

Hardwall also efficiently shields your system from viruses and accidental configuration changes. For example, it can set the boot partition of your hard disk to "write many recoverable" mode. This means that you may write to the partition as often as required during a session, but each time you reboot the machine, all changes are set back to the initial state. If information in this partition is infected by a virus or corrupted, the defect will be removed automatically upon rebooting. Hardwall is not virus-specific, so you don't need to update virus-scanning software.

Hardwall is an intelligent virus isolator and antihacking device that can work in a desktop PC as well as in a Windows NT server. Its big advantage is that it operates separately from CPU and OS and therefore doesn't degrade system performance.

–Rainer Mauth

PHOTOGRAPH: STEVEN GREENBERG © 1998

Displays

Movable LCD Monitor Saves Space on Your Desk

SpaceSaver, a new 13.8-inch color LCD monitor, may be a good way to clear your desktop of bulky screens, peripherals, and cables. You can set the device on your desk and still move it around three axes to optimize your working environment. Its 90-degree viewing angle, in both horizontal and vertical planes, provides good contrast and brightness over the entire screen area. This monitor also serves as a hub for mouse, infrared keyboard, and serial ports, and it has two stereo speakers.

Price: Starts at $1200.
Contact: Source Development, Lognes, France, +33 1 64 62 63 63; http://www.source.com.
Enter HotBYTEs No. 1033.

Printers

New Laser Printer for Small Workgroups

Kyocera's new FS-600 small workgroup laser printer outputs six pages per minute at 600 dpi. This compact (225 x 353 mm, 7 Kg) printer includes a 150-sheet cassette plus manual bypass. The processor is a 50-MHz PowerPC 41GF. You can upgrade the device with an additional paper cassette for a second paper type or with a network interface. Standard emulations include PCL 5e, Epson LQ-850, KCGL, and line printer. You can also upgrade to PostScript 2.

Price: DM 860.
Contact: Kyocera Electronics, Reading, U.K., +44 118 931 1500; http://www.kyocera.com.
Enter HotBYTEs No. 1034.

Communications

Complete Video-Conferencing Solution

For videoconferencing, Liesegang U.K. bundles the RSI Video Flyer Rocket, equipped with built-in microphone and speakers, with a Sony camera and a 128-Kbps ISDN switch. The system runs on Macs, PCs, and notebooks and offers real-time videoconferencing on up to three parallel ISDN lines.

Price: £7995.
Contact: Liesegang, Birstall, U.K., +44 1924 423 331; http://www.liesegang.co.uk.
Enter HotBYTEs No. 1037.

Motherboard

Internet Server for Small Businesses

Complementing Olivetti's NetStrada server family, the NetStrada 1200

offers a Pentium II CPU running at 300 MHz and sophisticated Ultra-Wide SCSI peripheral bus technology. Equipped with on-board Ethernet and Fast Ethernet adapters, 512-KB L2 cache, and RAM expandable to 384 MB, it is built for use as an intranet or Internet server in small businesses. NetStrada 1200 ships with monitoring and network management software on CD-ROM.
Price: Starts at £1200.
Contact: Olivetti, London, +44 181 785 6666; http://www.ocwi.com.
Enter HotBYTEs No. 1039.

Hand-Held PCs

EPOC Device Includes Touchpad

GEOFOX-ONE, AN EPOC32-BASED HANDheld computer, is powered by an 18-MHz ARM-7 CPU and is fully compatible with Psion's Series 5 devices. An integrated e-mail client supports POP3 mailboxes and regular PC Card modems. For data input, the device features a soft-touch keyboard and a touchpad. The 17-cm LCD panel offers a resolution of 640 x 320 pixels. Two standard AA batteries let you use the gadget for up to 25 hours without changing the battery, the vendor says.

Price: £399.
Contact: Geofox, Cambridge, U.K., +44 1787 371 371; http://www.geofox.com.
Enter HotBYTEs No. 1038.

Web Appliance

Surf the Web on Your TV

SURFTV, A MULTIMEDIA SET-TOP BOX, LETS you read and answer fax or e-mail messages and browse the Web on your TV screen. The device has a small digital camera for videophone services. The box connects to the TV or to the Internet (via a built-in modem). SurfTV runs the QNX real-time OS and includes a Web browser with video plug-in technology. A high-end version comes with a CD-ROM or DVD drive.
Price: Starts at FF 3000.
Contact: Com One, Cesta, France, +33 556 788400; http://www.com1.fr.
Enter HotBYTEs No. 1044.

Security

Firewall Handles Address Translation

CIPRO-FW, A HARDWARE-BASED FIREwall, guards intranets from illegal access, allows VPN tunneling over the Internet, and controls access to corporate LAN and WAN environments. Its Fast Ethernet capability offers communication speed up to 100 MBps and supports standard IP applications as well as remote user authentication, network address translation, and advanced security auditing.
Price: Starts at £6950.
Contact: Radguard, Tel Aviv, Israel, +972 3645 5489; http://www.radguard.com.
Enter HotBYTEs No. 1045.

Embedded Systems

48 I/O Channels on One Board

BLUE CHIP TECHNOLOGY'S NEW PC/104 form-factor module provides up to 48 digital I/O channels on an embedded Pentium board. The APX-PIO board offers a reliable mechanism for implementing additional digital I/O channels in embedded control applications. Maintenance and configuration of I/O channels is possible via software.
Price: Call company.
Contact: Blue Chip Technology, Chester, U.K., +44 1829 772 000.
Enter HotBYTEs No. 1046.

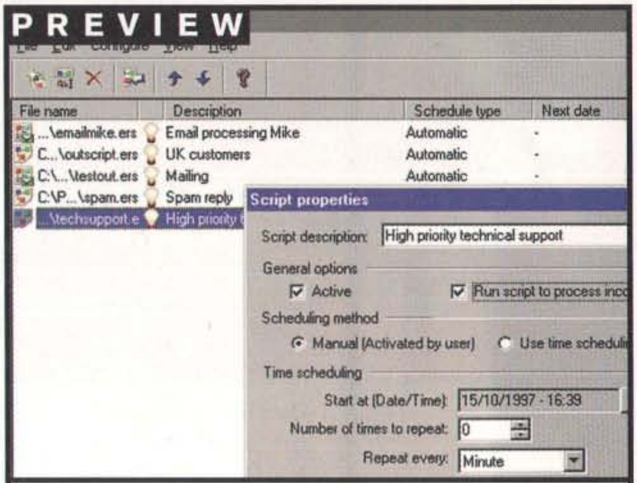
SOFTWARE

Business

Accounting Package for Macintosh

WITH FEATURES LIKE CASH MANAGEMENT, accounting, and calculation of early settlement discounts, Bottom Line aims at small- and home-office users who need to satisfy auditors, banks, or VAT inspectors. The Mac OS-based bookkeeping software produces VAT returns and EC sales lists so users can prepare invoices and maintain credit control. It offers flexible reconciliation procedures, departmental breakdowns, and budgetary control features.
Price: £99.
Contact: Forecast Systems, Bristol, U.K., +49 117 950 5033; http://www.forecast.co.uk.
Enter HotBYTEs No. 1059.

PREVIEW



File name	Description	Schedule type	Next date
...\emailmike.ers	Email processing Mike	Automatic	-
C...\outscript.ers	UK customers	Automatic	-
C:\...\testout.ers	Mailing	Automatic	-
C:\P...\spam.ers	Spam reply		
...\techsupport.e	High priority		

Script properties

Script description: High priority technical support

General options
☑ Active ☑ Run script to process inco

Scheduling method
● Manual (Activated by user) ○ Use time scheduli

Time scheduling
Start at (Date/Time): 15/10/1997 - 16:39
Number of times to repeat: 0
Repeat every: Minute

Emailrobot 2000
$595 for server;
$100 for client

Enter HotBYTEs No. 1060.

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http://www.gfifax.com

Robot Filters E-Mail Influx

For most businesses, e-mail has become as indispensable as the telephone. As the number of users grows, companies are struggling to efficiently manage and expedite e-mail traffic.

Emailrobot 2000 routes, answers, archives, and tracks messages automatically. It stores and analyzes e-mail on a central server, capturing such details as response times, responder, and answer to a message. The program provides a retrieval mechanism for complete communication with a customer. Using Emailrobot's reporting function, you can calculate the amount of e-mail received per day, check correctness of replies, monitor response time per department, and find out whether the load is evenly shared.

Emailrobot easily automates routine e-mail tasks. For example, it sends out personalized responses on the basis of keywords or e-mail domain names and routes incoming messages to specific databases. Defining routing functions is easy: All you have to do is follow a series of setup wizards. For more complex conditional routing, you can use a straightforward scripting language.

The program comes in versions for SMTP and POP3 mail servers as well as for Microsoft Exchange Server. Individuals can use the Emailrobot client as a plug-in for Eudora or Microsoft Outlook.

–Rainer Mauth

Communications

WinPhone Manages PSTN and Internet Telephony

WITH VERSION 4.5 OF MEGASOFT'S TELEPHONY program WinPhone, you can operate analog, ISDN, mobile communications, and Internet telephone calls in one program. Even in the middle of a call you can switch between PSTN and Internet telephony or use the H.32x videophone capabilities. Additional features include whiteboards, application sharing, remote access, file transfer, chat, and least-cost routing. WinPhone lets you dial from any application and displays incoming caller IDs in all running applications.
Price: Call company.
Contact: MegaSoft, Vienna, Austria, +43 470 2022.
Enter HotBYTEs No. 1053.

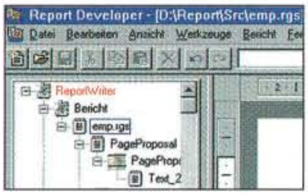
Watch Web Site Hits

IF YOU WANT TO KNOW HOW EFFECTIVE OR popular your Web site is, check out Real Time Spy. It allows you to monitor routes taken by visitors, the origin of traffic, frequency of hits, and efficiency of links on a mirror site. Details are stored in a password-protected relational database and are instantly available from your intranet.
Price: Call company.
Contact: The Gauge Group, London, +44 171 717 1553;
http://www.gauge.co.uk.
Enter HotBYTEs No. 1052.

Data Management

Report Generator for Multiple Platforms

REPORT DEVELOPER IS A MULTIPLATFORM report generator for use in large corporations. It uses a multidocument interface to simultaneously generate reports and represents each report in a hierarchical tree. The system's big advantage is its wide support for heterogeneous networks and a variety of databases such as Oracle, Informix, Sybase, Gupta, ADABAS, DB/2, SQL Server, and ODBC. A layout editor allows you to position all report elements via dragging and dropping.



Price: DM 1850.
Contact: GFT Software, St. Georgen, Germany, +49 7724 94110;
http://www.gftsoftware.com.
Enter HotBYTEs No. 1049.

Data Mining

ActiveX Components Control Neural Nets

NEUFUZZY, A FUZZY LOGIC AND NEURAL network program, combines the benefits of intuitive rule-based modeling with the trainable intelligence of neural networks. It offers a Rule-Fire Matrix that can be interrogated from within an ActiveX application. The system enables ActiveX developers to study how a neuro-fuzzy network makes decisions and lets them build ActiveX applications for data mining.
Price: Call company.
Contact: NCS, Totton, U.K., +44 1703 667 775;
http://www.ncs.co.uk.
Enter HotBYTEs No. 1058.

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THE NEW UNIFIED MESSAGING SERVER (UMS) integrates fax, voice, GSM, and telex communications in one single environment. You can send faxes and GSM messages from any Windows application and access incoming voice mail from standard phones or your GSM handset. It is also possible to redirect faxes and e-mail to temporary fax machines. UMS supports Internet-Mail, MS Exchange, Lotus Notes, cc:Mail, and Novell GroupWise.
Price: Call company.
Contact: Digitronic, Holm, Germany, +49 410 388 672;
http://www.digitronic.de.
Enter HotBYTEs No. 1055.

MRS Includes Universal Inbox

MRS 3.0 INTEGRATES TEXT, FAX, VOICE, AND e-mail messages in one universal mailbox system that you can access with a wide range of client software. The system uses a single directory and address book for all services. In addition, the program can send a single document simultaneously as fax, e-mail, data file, or voice mail. It integrates with MS Exchange, Lotus Notes, cc:Mail, and SAP R/2 and R/3.
Price: Starts at DM 5000.
Contact: PP-Com, Alsdorf, Germany, +49 240 490 660;
http://www.ppcom.com.
Enter HotBYTEs No. 1056.

Multimedia

Edit MPEG-2 Streams in Software Only

YOU CAN DO ACCURATE FRAME EDITING OF MPEG-2 clips without the need for dedicated hardware to play back data. Video Clip MPEG-2, a nonlinear editing package, offers the basic copy and paste functions for editing MPEG-2 files (i.e., multiplexed data including MPEG-2 video and MPEG-1 audio). The program is available in a "light" version that allows for editing of I-frames, and in a professional B-frames version. The current versions support constant-bit-rate MPEG-2 streams, but the vendor says that support for variable bit rates will follow soon.

Price: $200 for light version; $1250 for professional version.
Contact: Vitec Multimedia, Chatillon Cedex, France, +33 1 46730606;
http://www.vitecmm.com.
Enter HotBYTEs No. 1050.

Engineering

Document Management System for CAD

DM FOR AUTOCAD 14 HELPS AUTOCAD users manage technical documents. It integrates into AutoCAD's menus or toolbars and displays lists of drawings and documents. The DM server synchronizes concurrent access to document repositories via an intranet. To preserve the integrity of drawings, DM requires engineers to check-out drawings for revision. A revision control system makes sure users can assess how the changes in one drawing affect other drawings.
Price: Call company.
Contact: Cimage, Bracknell, U.K., +44 1344 860 055;
http://www.cimage.co.uk.
Enter HotBYTEs No. 1057.

Web

Ecopad Speeds Up Internet Access

ECOPAD SPEEDS UP INTERNET AND INTRANET applications by compressing HTML pages on the fly. It uses a variety of adaptive compression methods. For example, it compresses pictures differently than text, removes redundant information, and uses tricks like preparing (but not prefetching) links out of the page. It speeds up arbitrary page access between two and five times, Synchronix says. To capitalize on this improvement, the vendor adds, you need the Ecopad software both on the server and on the client.
Price: Call company.
Contact: Synchronix, Les Ulis Cedex, France, +33 1 64 46 2626;
http://www.synx.com.
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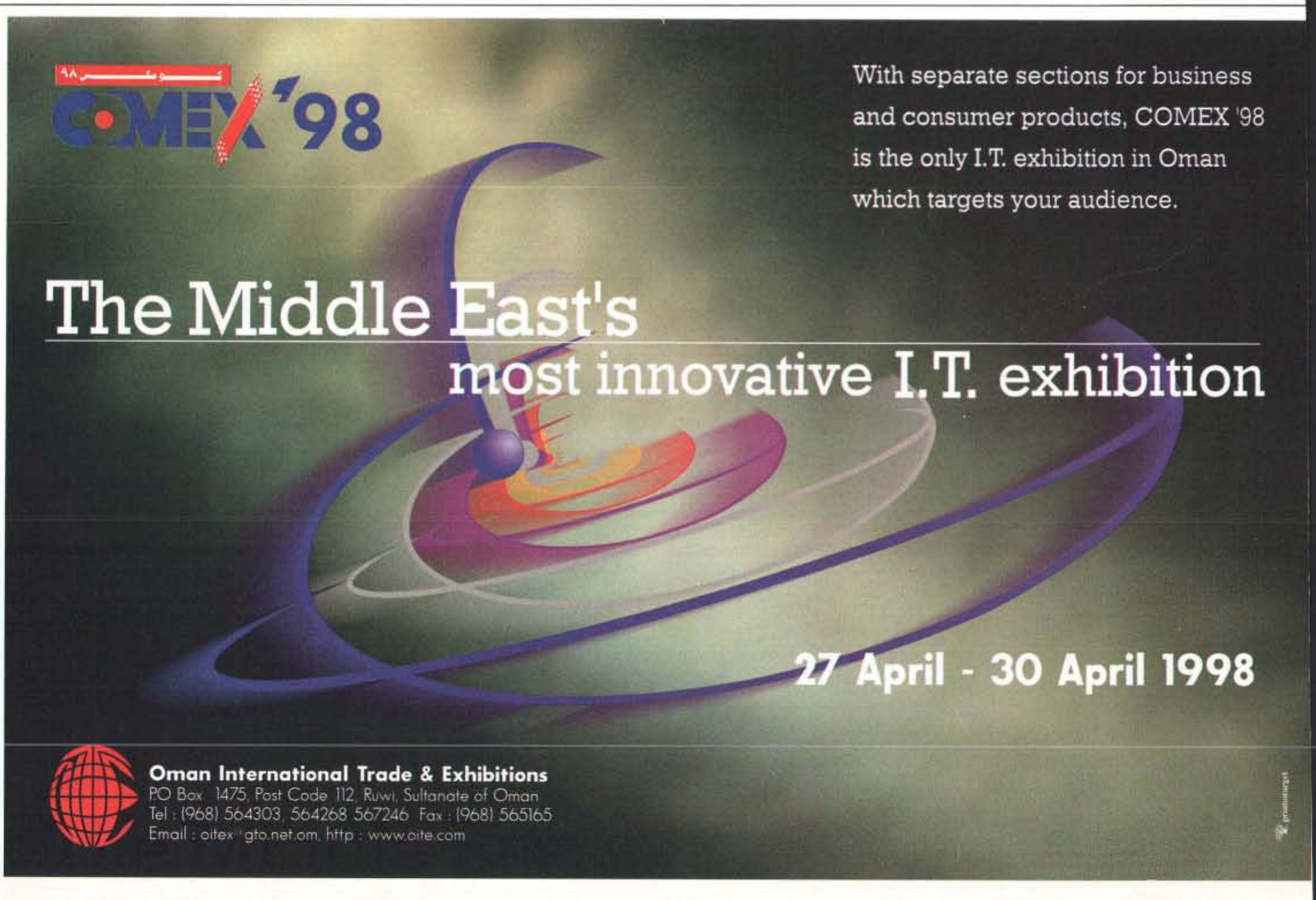

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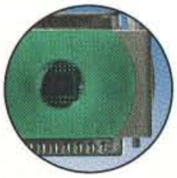

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HTP.

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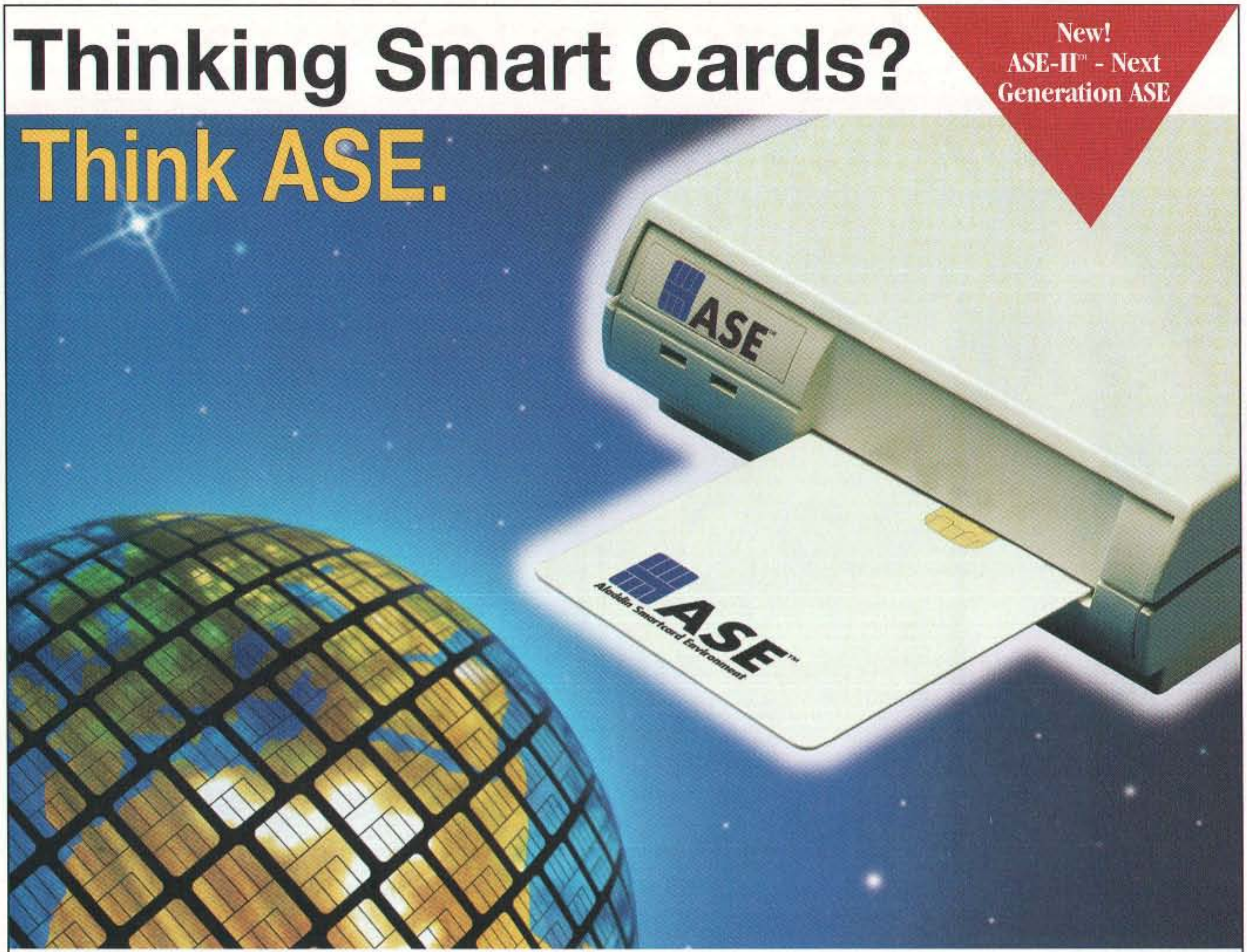

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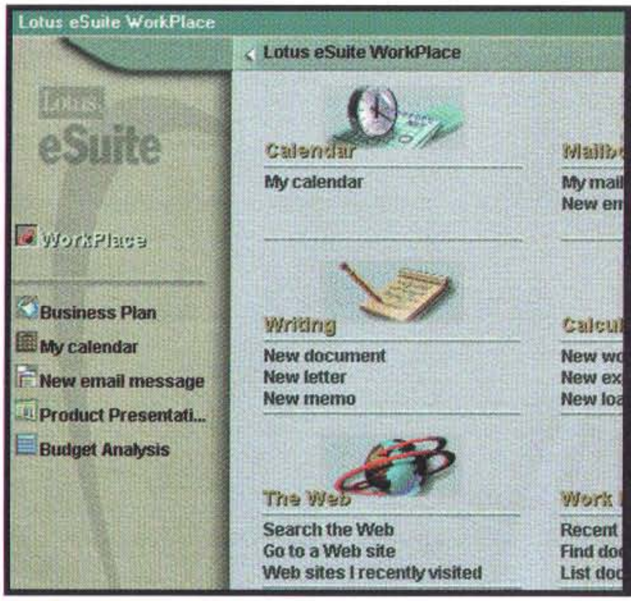
A pared-down desktop built around JavaBean applets offers an interesting challenge to Office and IE 4. ***By Steve Gillmor***

A Different Desktop for the WorkPlace



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Cambridge, MA

800-343-5414
617-577-8500

http://www.esuite.lotus.com/

Enter HotBYTEs No. 1073.

In eSuite, the taskbar at left serves as a "channel switcher," while the central section is the user's main work area.

A server-based desktop that provides just 20 percent of "normal" office-suite features could change the way many people work. Lotus's JavaBean-based eSuite, aimed first at network computers, offers an elegant user interface and sophisticated development tools. Whether you're moving from green screens to intranet work flow, or using Web servers and thin clients, eSuite gives you a great deal more than the sum of its parts.

WorkPlace is the task-oriented user environment, and DevPack is a set of tools for Web application developers. The two share word processor, spreadsheet, and presentation-graphics components. WorkPlace also has e-mail, calendar, address book, browser, and file manager components. The desktop gives you a taskbar and a work area that first displays a set of categorized tasks.

Below the work area, the InfoCenter combines Windows 95's taskbar with Notes' InfoBox properties control panel. It's a context-sensitive, single-click action bar with pop-up menus for some commands and a floating panel for setting properties (fonts, etc.). Windows users will feel at home, and shortcut keys perform as expected.

TECH FOCUS

InfoBus for the Infobahn

The InfoBus provides events and bound properties for directly interconnecting Java components that produce, consume, or control data. eSuite's spreadsheet publishes data to the InfoBus by explicitly naming a range of cells. Give that name to the Chart applet and you've established a data flow between them. In complex applications, data controllers can help manage requests and announcements, caching broadcasts and funneling messages to their destination. Once a link is established, data flows directly, not using the InfoBus.

At log-in, a registry restores your desktop to its previous state, including preferred mail and file servers. Most eSuite components are less than 750 KB, for fast downloading. There isn't yet a local-replication version for mobile use.

With the DevPack you can program access to all WorkPlace components but mail, calendar, and address book. The package adds Chart and Project Scheduler, plus JDBC and CGI data-access applets. Using Lotus' InfoBus technology and JavaScript on an HTML page, for example, a pie-charting component can graph numbers taken from an embedded eSuite spreadsheet. AppletContainer lets you preload applet instances and manage InfoCenter layouts, and InfoBusBridge converts between JavaScript-generated strings and InfoBus data.

Notes users will like eSuite's small footprint, but they will need Notes 4.6x to support component embedding and persistence. I added Project Scheduler to a Notes form, but it didn't save my data.

eSuite's JavaBeans architecture gives developers an easy way to add features, and handing computation to the client minimizes network traffic and speeds response. As Java moves to the enterprise, Lotus has carved out a niche that clearly challenges Microsoft and ActiveX. ■

RATINGS	
TECHNOLOGY	★★★★★
IMPLEMENTATION	★★★★

Steve Gillmor is with Southern Digital, in Charleston, South Carolina, and at **http://www.southerndigital.com.**

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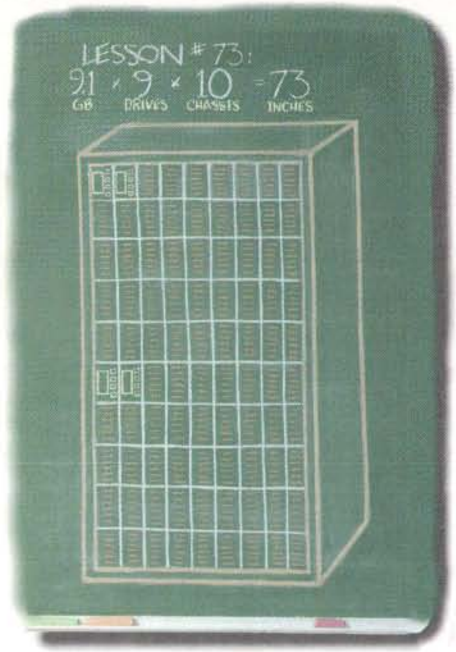

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9.1 X 9 X 10 = 73

Other entry-level RAID systems require you to anticipate your future storage needs due to confusing choices in controllers and enclosures. Graduating to the next level becomes difficult, if not impossible. LynxArray™ gives you true scalability by featuring the same controller and enclosure architecture whether you have 9 drives or 90 drives. You can start with a deskside tower using 9.1GB drives, increase your capacity ten times and move to a 73.5" rack with 100% investment protection.

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Enter HotBYTEs No. 113 at http ://www.byte.com/hotbytes/

With Pentium II-humbling performance and affordable prices, these Alpha systems are irresistible. **By Tom Yager**

Three Vendors Make an Alpha Bet

Now that Intel has taken the Alpha processor into its fold, we can be more hopeful about the future of Digital's former chip in Windows systems. Yet issues of software compatibility and cost remain. With so much to consider in deviating from the no-brainer Intel x86 course, why should anyone bother?

Spend time with any of the three workstations we reviewed from Aspen Systems, Polywell Computer, and Tri-Star Computer—all based on Digital's smaller, lower-cost Alpha 21164PC chip—and you'll have your answer: *speed*. According to the BYTEmark tests, a 300-MHz Pentium II will do the work of four to five 90-MHz Pentium machines (the BYTEmark baseline). Based on the same tests (results shown below), these 533-MHz Alphas give you 7 to 9 times the performance boost. If you're running compute-bound applications or services, that's a leap worth taking.

B ASPEN DURANGO II

RATINGS	
TECHNOLOGY	★ ★ ★ ★ ★
IMPLEMENTATION	★ ★ ★ ★
PERFORMANCE	★ ★ ★ ★ ★

POLYWELL 533SX

RATINGS	
TECHNOLOGY	★ ★ ★ ★
IMPLEMENTATION	★ ★ ★
PERFORMANCE	★ ★ ★ ★

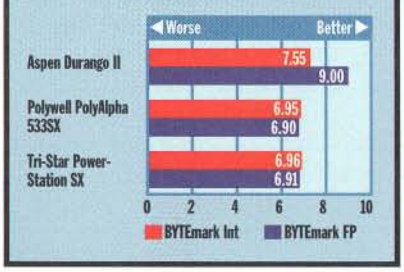
TRI-STAR POWERSTATION

RATINGS	
TECHNOLOGY	★ ★ ★ ★
IMPLEMENTATION	★ ★ ★
PERFORMANCE	★ ★ ★ ★

Aspen Systems Durango II

Aspen Systems sent me a machine built around its Durango II base, an adaptation of the Digital 164SX motherboard. IntraServer Technology supplied Aspen's dual-channel Ultra Wide SCSI adapter, which cleverly shares a 32-bit PCI card with a 10/100-Mbps Ethernet adapter. The test system also included a 64-bit PCI AccelGraphics AccelPro TX2500 OpenGL accelerator with 16 MB of RAM.

BYTEmarks Performance



Running on a 3Dlabs Glint 500TX chip set, the AccelPro pulls Windows NT's OpenGL shading operations into hardware. Using the native Alpha version of Lightwave 3-D 5.5, the AccelPro had no trouble tumbling shaded, moderately complex 3-D models in real time. Its 2-D performance is excellent as well. Resolution reaches up to 1600 by 1200 pixels, but oddly, true color is only available up to 1152 by 864. This may limit the card's appeal for publishing and image-manipulation applications.

Aspen's machine impressed me by having nothing plugged into its CPU-hogging IDE controllers. Instead, the IntraServer Ultra Wide SCSI adapter drives everything, from the dual 4.55-GB Seagate hard drives to the 12X CD-ROM.

The cabinet, which Aspen has in common with Tri-Star, is this system's worst feature. The DIMM sockets are obscured by the 3½-inch drive cage. The inside of this system feels crowded. Upgrading it takes plenty of time and light.

However, the Aspen Systems Durango II was tops in the BYTEmark tests. The cabinet aside, I like the way this system is built. At $6424, it's not your average home computer, but anyone with the

PHOTOGRAPHS: STEVEN GOLDBERG © 1998

need for serious CPU and graphics performance will be well served by this machine.

Polywell PolyAlpha 533SX

While Aspen shipped me its 3-D power desktop configuration, Polywell sent its commodity contender. That's no slight. I was pleased to see it, or I was until I discovered that all its drives are connected to the 164SX's on-board IDE controllers. Pairing the mouth-watering performance of the 533-MHz Alpha chip with department-store IDE hard drives leaves me cold, even if it does save the buyer money. Like most integrators, Polywell sells and configures SCSI adapters and drives for its customers. At this performance level, however, perhaps it should make SCSI hardware standard.

In other regards, I found much to like about the PolyAlpha in addition to its price. The cabinet's interior is open and spacious; nearly the entire motherboard is viewable, and adding RAM and full-length cards is no trouble.

I approve of Polywell's choice of the Matrox Millennium II 4-MB video card. It's a 32-bit card, and it doesn't accelerate OpenGL, but it does deliver superb 2-D performance at an affordable price. The standard 64 MB of RAM is adequate for basic applications, but you may need to upgrade to 128 MB to accommodate larger Alpha applications (which are typically 30-40 percent bigger than their Intel counterparts).

Inexplicably, this system lagged behind the Aspen Durango II in the BYTEmark tests. The Polywell is very respectable, considering the price, but the speedier Durango II can also be trimmed to a lower-cost configuration. Still, the PolyAlpha is a worthy, competitively priced system. If you order one, I'd suggest asking Polywell to replace the IDE drive with SCSI. Unless you do, you'll never experience true Alpha performance.

Tri-Star PowerStation SX

Somewhere between the commodity Polywell and the lavish Aspen rests Tri-Star's 164SX-based Alpha PC. As configured for this review, Tri-Star's desktop Alpha (which took a BYTE Best of Show award at Fall Comdex '97) is an affordable 3-D graphics workstation. Like Polywell, Tri-Star makes its workstation affordable by using IDE drives and cutting back on RAM.

The Tri-Star system's cabinet is just as crowded inside as the Aspen's. The motherboard is Digital's 164SX, like Polywell's, so all slots will accommodate full-length cards without trouble. The Quantum 6.4-GB hard drive performs as well as any IDE drive, but again, it's a poor match for such a fast machine.

The ELSA Gloria-L 64-bit PCI graphics card is based on the 3Dlabs Glint 500TX chip set, so its available resolutions and 2-D performance, not surprisingly, mirror that of the AccelPro found in Aspen's workstation. ELSA adds a system tray utility that purports to optimize the card's settings for the application you're running. Selecting ELSA's "Lightwave 3D" setting, however, caused Lightwave to crash reproducibly until I disabled the Gloria-L's 3-D acceleration. The Gloria-L card caused no problems with ordinary applications, but Lightwave is the only native Alpha OpenGL application I tested.

In performance, the Tri-Star and Polywell don't differ significantly. In attempting to commoditize the Alpha PC, Tri-Star and Polywell have cut corners that seriously affect the perceived value of their systems. These two systems would benefit from a SCSI controller and a striped pair of Ultra Wide drives.

My "best of group" nod goes to Aspen Systems' Durango II, not for its muscular (and more costly) review configuration, but for its workstation performance. The IntraServer SCSI/network controller and the AccelGraphics 3-D accelerator add to the system's stable, capable feel. If you think the Pentium's pace of improvement is too slow, any of these Alpha systems will raise your interest. Just take care how you configure them; saving money shouldn't mean giving up what's best about a high-performance computer. ■

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*Tom Yager (***tyager@maxx.net***) is a technical analyst and writer based in north Texas.*

TECH FOCUS

Something in Common: AlphaPC 164SX Motherboard

The three machines I tested are truly cut from the same cloth. All rely on some adaptation of Digital's (ATX standard) AlphaPC 164SX motherboard. The connectors for dual DB9 serial, parallel, PS/2 mouse, and PS/2 keyboard ports are soldered directly to the motherboard. Familiar Pentium ATX motherboard extras like video, networking, universal serial bus (USB), SCSI, and sound are absent here. In fact, none of the systems reviewed had sound cards, which can be helpful even for serious work.

The 164SX motherboard gives you room for two pairs of 168-pin, unbuffered synchronous DRAM (SDRAM) DIMMs. Using 128-MB DIMMs, you can squeeze 512 MB of RAM into your machine. The CPU is heavily cached, with internal 8-KB instruction and data caches, a 96-KB Level 2 shared cache, and 2 MB of synchronous static Level 3 cache RAM on the motherboard.

The 164SX's on-board hard disk controller is Enhanced IDE, a choice I found surprising in a high-performance machine. Far less expensive Pentium Pro and Pentium II motherboards come with an on-board Ultra Wide SCSI controller. Fortunately, the 164SX has plenty of room for expansion: two dedicated ISA slots and four PCI slots (two 32-bit, two 64-bit).

PRODUCT INFORMATION

Aspen Systems Durango II
$6424
(128 MB of RAM; IntraServer dual-channel Ultra Wide SCSI controller with 10/100 Ethernet; dual 4.5-GB Seagate Ultra Wide hard drives; AccelGraphics AccelPro 3-D accelerator with 16 MB RAM; Toshiba 12X SCSI-1 CD-ROM drive; Windows NT Workstation 4.0)
Aspen Systems
Wheat Ridge, CO
800-992-9242
http://www.aspsys.com
Enter HotBYTEs 1070.

Polywell Computer PolyAlpha 533SX
$2249
(64 MB of RAM; Maxtor 7-GB EIDE hard drive; Matrox Millennium II display adapter with 4 MB of RAM; 24X IDE CD-ROM; Digital 10/100 Ethernet adapter; Windows NT Workstation 4.0)
Polywell Systems
South San Francisco, CA
415-583-7222
http://www.polywell.com
Enter HotBYTEs 1071.

Tri-Star 533-MHz PowerStation SX
$2599
(64 MB of RAM; Quantum 6.4-GB EIDE hard drive; ELSA Gloria-L 3-D accelerator; Mitsumi 12/24X CD-ROM drive; Windows NT Workstation 4.0)
Tri-Star Computer
Phoenix, AZ
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- Two Analog Ports Supported
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- Multiple Subscriber Numbering
- BACP Protocol
- V.120 and V.110 Rate Adaptation
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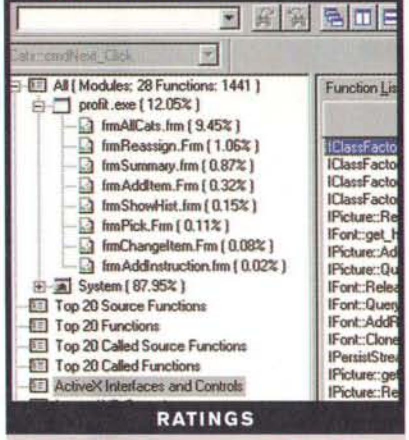
NuMega's TrueTime and Rational's Visual Quantify pinpoint performance bottlenecks. ***By Steve Apiki***

Profilers for a Component World

TRUETIME 1.0

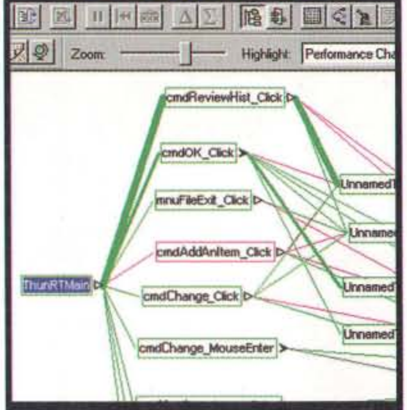


Calls::cmdNext_Click

- All (Modules: 28 Functions: 1441)
  - profit.exe (12.05%)
    - frmAllCats.frm (9.45%)
    - frmReassign.Frm (1.06%)
    - frmSummary.frm (0.87%)
    - frmAddItem.Frm (0.32%)
    - frmShowHist.frm (0.15%)
    - frmPick.Frm (0.11%)
    - frmChangeItem.Frm (0.08%)
    - frmAddInstruction.frm (0.02%)
  - System (87.95%)
- Top 20 Source Functions
- Top 20 Functions
- Top 20 Called Source Functions
- Top 20 Called Functions
- ActiveX Interfaces and Controls

RATINGS	
TECHNOLOGY	★ ★ ★ ★
IMPLEMENTATION	★ ★ ★ ★ ★
PERFORMANCE	★ ★ ★

VISUAL QUANTIFY 4.0



RATINGS	
TECHNOLOGY	★ ★ ★ ★
IMPLEMENTATION	★ ★ ★ ★
PERFORMANCE	★ ★ ★

Rapid application development doesn't often, unfortunately, lead to the development of rapid applications. NuMega's TrueTime and Rational's Visual Quantify seek to remedy this by analyzing the performance of component-based Windows software. Both profilers "instrument" Windows programs: They add instructions that unobtrusively time each line of source as the program runs (see the Tech Focus), then provide timing results in a variety of formats.

TrueTime's strength is its clear, immediate presentation of the most relevant data. It displays a tree view that splits modules in your code from the rest of the system, then ranks each module by the amount of time it consumed. You can see line-by-line timing results presented alongside your source, or detailed function analysis that shows pie charts ranking each caller and callee by call frequency. TrueTime's straightforward analysis gets you to the performance bottlenecks in your code within a few mouse clicks.

TrueTime works with Visual Basic only, and it can time ActiveX components written in VB, but it can't instrument components developed in Visual C++, even with the source. Fortunately, TrueTime can delve deeply into those components, providing timing for ActiveX interfaces exported from controls.

TECH FOCUS

Code Instrumentation

Visual Quantify and TrueTime "instrument" code, inserting monitoring instructions into the program being tested. As the program runs, the instrumentation code counts line and function hits. TrueTime works as Visual Basic compiles, using the VB compiler to parse the Basic code, then adding instrumentation before the object code is generated. Visual Quantify starts with a linked executable and injects instructions. Visual Quantify counts instructions and calculates timings, while TrueTime measures elapsed time.

Visual Quantify works equally well with VB, VC++, and Java. To test a VB or VC++ application, you run Visual Quantify and point it at the executable. Instrumentation is faster with Visual Quantify than with TrueTime (14 seconds versus 35 in our test program), but because so many modules are instrumented the first time through, the initial load process is long. You can profile your own VC++ components from within your VB application right down to each source line.

Visual Quantify's main results screen is a call graph, which I found harder to use than TrueTime's results display. Visual Quantify does have unique analysis tools; the best of these, a "delta" analysis, lets you visually compare different runs on the call graph. This is the easiest way I've seen to evaluate the effects of making performance-oriented changes.

Both TrueTime and Visual Quantify do the job, delivering much the same information. Both products are evolving: Versions of TrueTime for Visual C++ will give it better coverage, while Rational plans a clearer user interface in upcoming releases. Right now, TrueTime's better presentation gives it an edge, making it the better choice for VB developers. ■

PRODUCT INFORMATION

NuMega TrueTime 1.0	**Rational Visual Quantify 4.0**
$399	**$550**
(Windows 95, NT)	**(NT 3.51 or higher)**
NuMega Technologies	**Rational Software**
Nashua, NH	**Cupertino, CA**
800-468-6342	**800-228-9922**
603-578-8400	**408-863-9900**
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Steve Apiki, a programmer and BYTE consulting editor, can be reached by e-mail at **apiki@AppropriateSolutions.com.**

New forms of persistent queries are necessary to handle live business data as it speeds through a company. ***By Dale Skeen***

Real-Time Queries in the Enterprise

Increasing the speed and accuracy of business execution translates into a significant competitive advantage. Corporations are thus transforming themselves into real-time enterprises, where they can immediately communicate, analyze, and act on business information as it occurs.

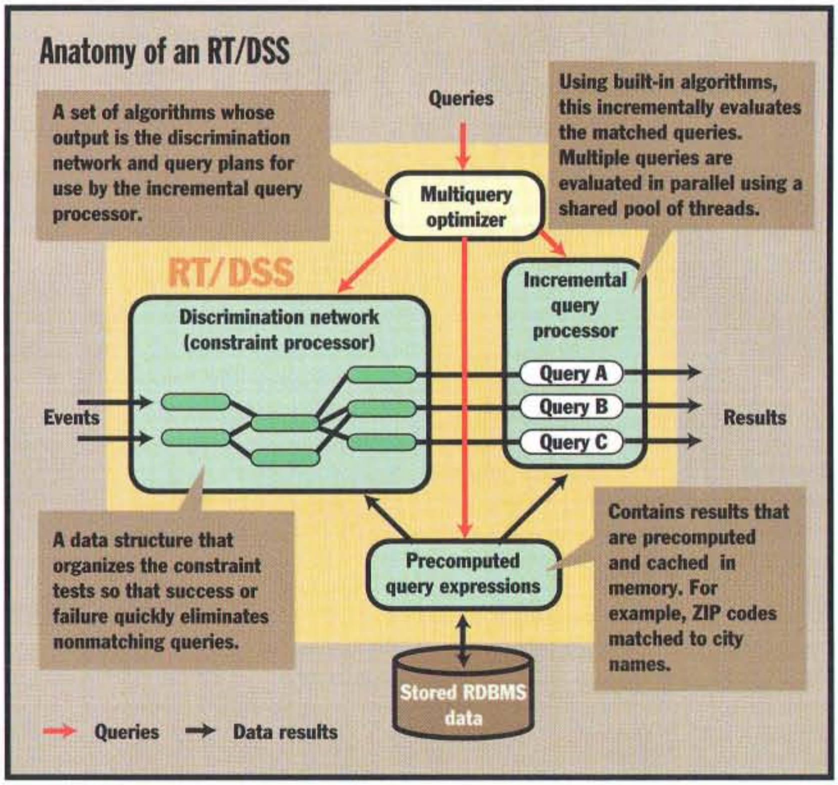
Last month, I explored event communications services (ECSes) and how they enable the scalable, real-time communication of business events. Together, the ECS and a new type of real-time/decision-support service (RT/DSS) form a Web-like infrastructure of real-time information. This infrastructure allows for rapid decision making, and it enables new business-automation services that respond automatically to specific business events. In this article, I explore these RT/DSSes.

Decision-Support Services

The advent of relational databases enabled general-purpose DSSes. With these tools, you could simply ask decision-support queries instead of having to program them. Similarly, the advent of event-driven technology enables new decision-support tools that can consume and analyze events almost instantaneously. With these tools you can ask powerful, real-time queries, using a high-level query language, instead of having to program them.

General-purpose tools providing real-time query processing, referred to as RT/DSSes, are becoming commercially available, such as Vitria's Martini product. Now, the manager of a large shipping hub for an express package-shipping company can request "to monitor shipment volume and changes thereto as new packages are picked up and existing packages rerouted." Unlike database queries, real-time queries typically are long-lived—a query may live from hours to months, depending on the information being monitored. Also, an RT/DSS must support concurrent query processing, because it's common to have thousands of real-time queries active all at once.

RT/DSS query processing is fundamentally different from traditional query processing. Rather than optimizing the bulk evaluation of a single on-line query across a large number of records, an RT/DSS optimizes the incremental evaluation of a single event (i.e., a single data change, say, a transaction) against a large number of continuous queries. Hence, an RT/DSS has to solve two hard query-optimization problems not found in traditional query processing.



Anatomy of an RT/DSS

A set of algorithms whose output is the discrimination network and query plans for use by the incremental query processor.

Using built-in algorithms, this incrementally evaluates the matched queries. Multiple queries are evaluated in parallel using a shared pool of threads.

A data structure that organizes the constraint tests so that success or failure quickly eliminates nonmatching queries.

Contains results that are precomputed and cached in memory. For example, ZIP codes matched to city names.

Real-time query optimization uses three mechanisms (green) to expedite processing.

The first problem is incremental query optimization, consisting of algorithms for optimizing the ongoing evaluation of a single query (i.e., track the sales of red shirts sold in Copenhagen). The second problem is multiquery optimization, consisting of algorithms for optimizing the simultaneous, incremental evaluation of multiple queries (i.e., separately track, for each market in Europe, the sales of all red shirts).

To illustrate just how an RT/DSS works, consider a real-time query. Using the package-shipping example, you monitor package information that changes on a real-time basis, particularly as shipments are delayed or rerouted. At every destination city, it is important to monitor package volume and weight to properly allocate delivery equipment. Consider the real-time query: "Monitor the total weight, per destination city, of all large, priority packages."

This is expressed in SQL as:

```
select city.name
  sum(package.weight)
from package /*real-time*/,
  city/*stored*/
where package.weight>100
      and package.service =
        'priority'
      and package.zip =
        city.zip
      group by city.name
```

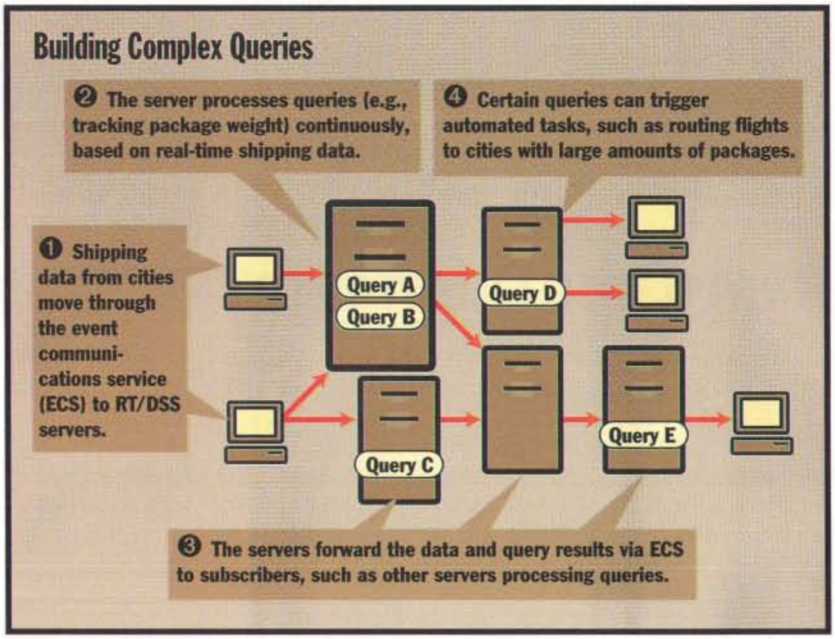
Although it's simply expressed, this query is subtly complex. It joins real-time, dynamically changing shipping-information events (the packages en route) with stored information (cities) that resides in a traditional database system. It contains a number of query constraints (priority service and weight over 100 pounds). It requires the grouping of this information by city and also the incremental computation of weight.

Real-time query optimization consists of three steps, as shown in the figure "Anatomy of an RT/DSS." The first step is to build a discrimination network that evaluates the query constraints. When a real-time event is received, the RT/DSS evaluates the event information against the discrimination network to efficiently identify all real-time queries whose constraints match the new information.

Note again that a potentially large number of constraints from a large number of concurrent queries might be tested. Hence, the discrimination network must be optimized so that constraints are tested in such a way that quickly identifies matching queries and discards those that don't match.

Step two is to derive incremental algorithms for computing the final query result. Once a query's constraints have been matched against the incoming event, the query's result needs to be incrementally evaluated. Continuing with the shipping example, if a package is rerouted to a new destination city, its weight must be subtracted from the old destination city's total and added to the total for the new destination city.

Step three is to prefetch and precompute, whenever possible, query expressions involving stored data and to cache the results in memory. This is done because directly accessing a database on each receipt of a real-time event is expensive, and, at high data rates, a database system simply can't keep up. Prefetching and precomputation let the RT/DSS overcome this bottleneck, speeding up both constraint matching and incremental result computations.



Building Complex Queries

➊ Shipping data from cities move through the event communications service (ECS) to RT/DSS servers.

➋ The server processes queries (e.g., tracking package weight) continuously, based on real-time shipping data.

➌ The servers forward the data and query results via ECS to subscribers, such as other servers processing queries.

➍ Certain queries can trigger automated tasks, such as routing flights to cities with large amounts of packages.

Because an ongoing query's results can be sent to other servers, complex queries can be built out of them.

Scaling

An RT/DSS service must be scalable in two dimensions: the ability to increase the number of concurrent queries, and the ability to share the results of processing a query to an increasing number of consuming applications and users. An RT/DSS uses the underlying ECS to both receive the events that drive real-time query processing and deliver the results of those queries to interested consumers.

For the package-shipping example, the RT/DSS processes a large number of queries (evaluating the number of heavy packages being shipped from various cities) and distributes the results (to all destination cities). Hence, as an RT/DSS computes the query results, it simply publishes the results on the underlying ECS.

A beneficial side effect of using an ECS is that this enables real-time queries to be *composed*. That is, the results of one query can be the input to another query, as shown in the figure "Building Complex Queries." Such daisy chaining of results permits the building of complex query results incrementally by leveraging the results of simpler queries.

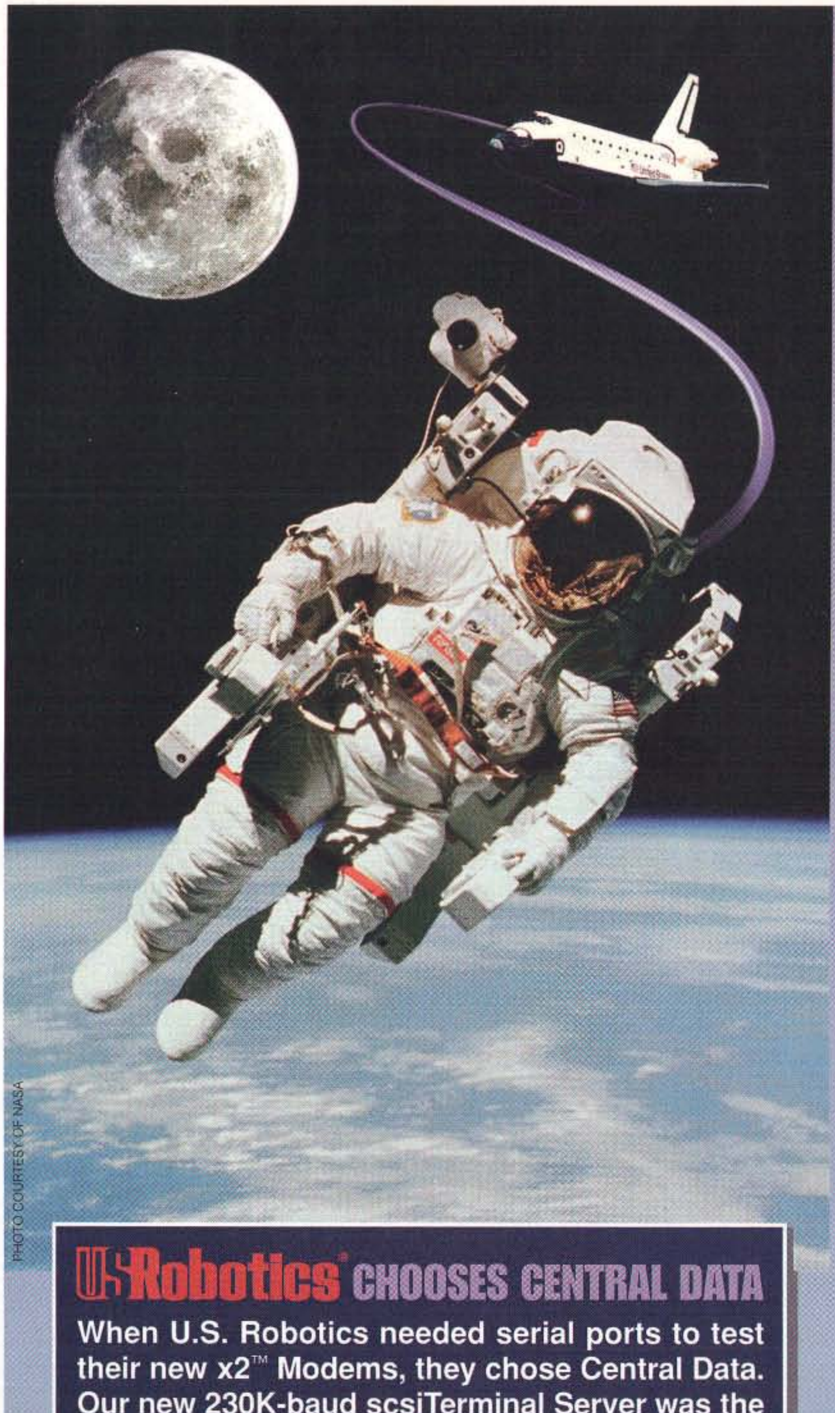
To scale the number of current real-time queries, an RT/DSS uses a federated architecture. If more processing power is required, you simply deploy new RT/DSS servers and rebalance the concurrent queries among the new servers.

Real-Time Reaction

One of the most practical results of an RT/DSS is that it enables business automation. For package shipping, an application with the proper event hooks could immediately respond to too many heavy packages delayed at Chicago by rerouting an aircraft there. Also, if the problem persists, the program could notify a supervisor to investigate, so that the company could change certain shipping routes.

In either case, responses to problems are immediate, rather than taking days or weeks for the problem to be discovered, much less resolved. By using Internet-based, distributed object standards, these new RT/DSS technologies can change the speed of business computing. B

Dr. Dale Skeen (**skeen@vitria.com**) *is CTO and cofounder of Vitria Technology, Inc.*



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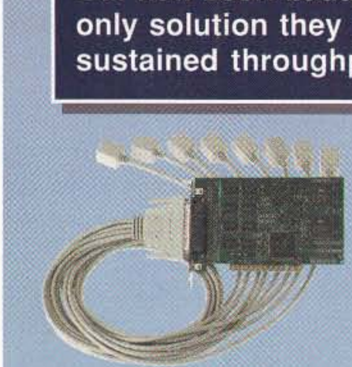

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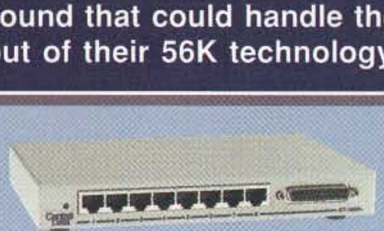

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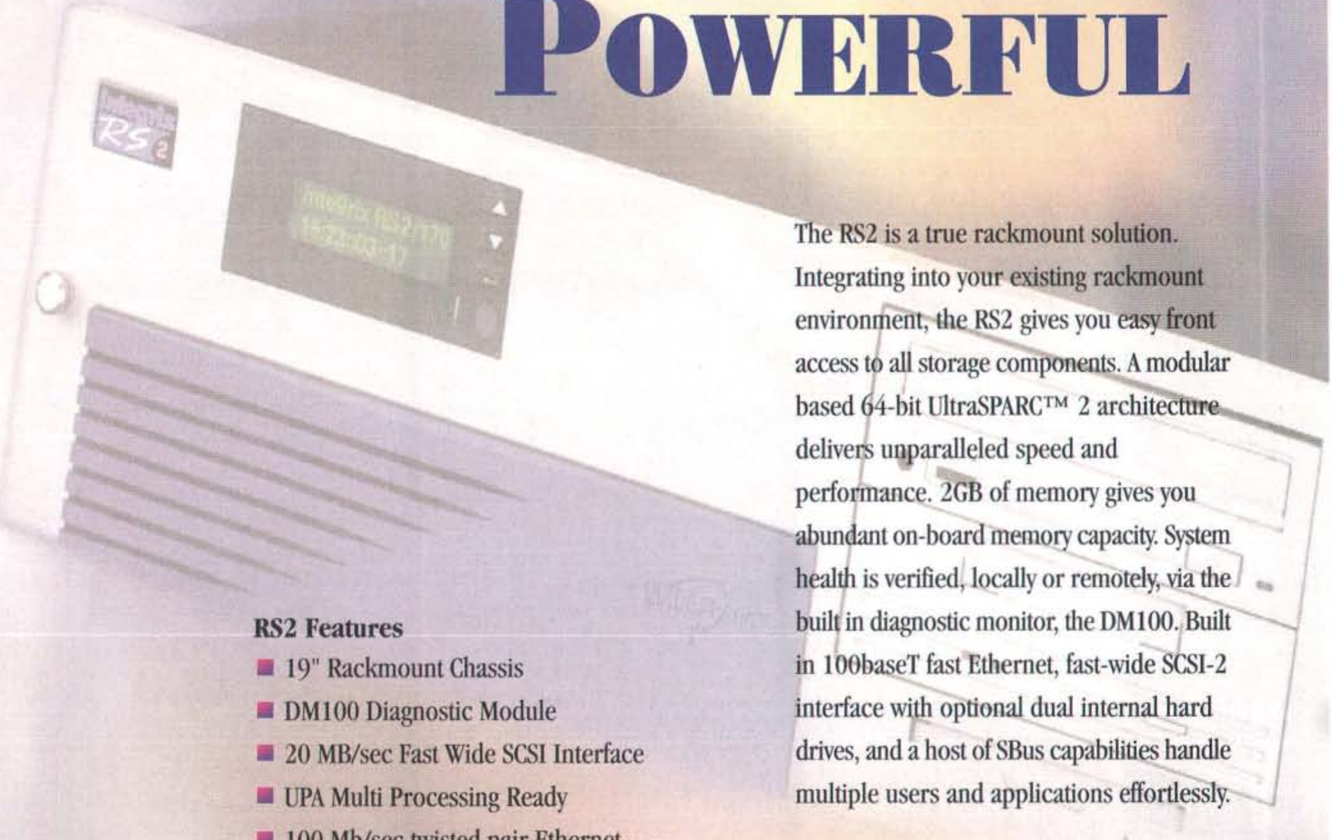

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This next generation of Java components lets you better control events and manipulate data. ***By Piroz Mohseni***

Glasgow Enhances JavaBeans

The JavaBeans component model has been one of the most successful enhancements Java has seen during its short life. Beans took Java and its object-oriented principles to a higher level by introducing a consistent framework in which Java components (Beans) could interact with each other. Glasgow is the code name for the next generation of JavaBeans.

JavaBeans' purpose is to take Java to the distributed-object world, where it has to compete with other component models, such as ActiveX. Therefore, certain enhancements, which are encompassed in Glasgow, became necessary.

The current specification of Glasgow consists of three parts. The first is an extensible run-time containment-and-services protocol. The second is the JavaBeans activation framework. The third is a drag-and-drop subsystem.

Bean Containers

The extensible run-time containment-and-services protocol is a component that lets Beans learn about their environment and the services it provides. This protocol addresses two fundamental issues related to a component model. The first is the establishment of a hierarchy relationship among the Beans. In a Windows-based environment, a well-defined relationship exists among an application's windows.

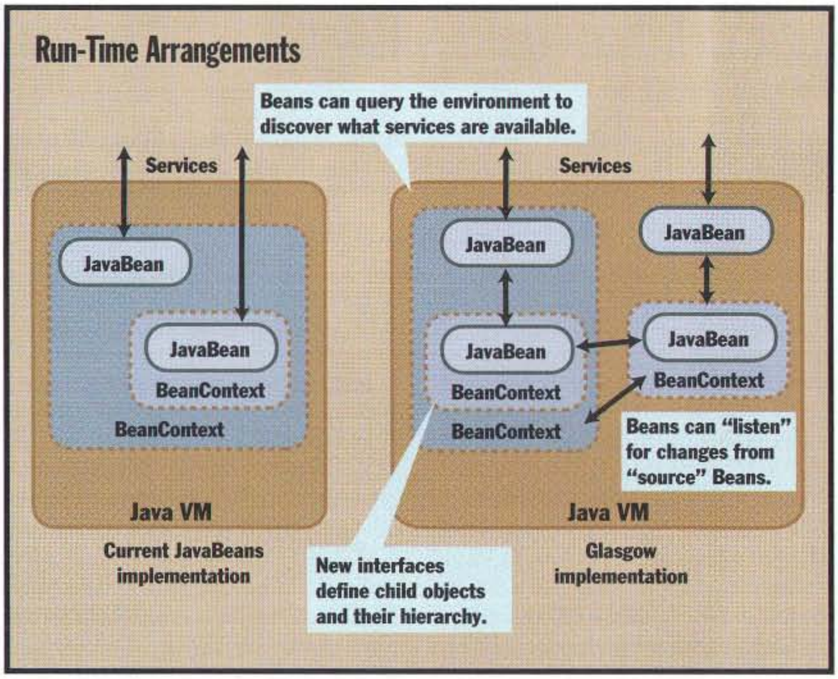
A dialog box, for example, is a child of a main window object. The focus for receiving events doesn't return to the parent window until the dialog box is dismissed. These types of relationships can and do exist among Beans, but no standard hierarchical arrangement is defined for them.

The second issue is the ability of a container to provide services to its components. A container is referred to as the *embedding context* in the Glasgow specification, and it's expected that it will provide a variety of services to its components. For example, a parent window may not let its components exist outside its boundaries.

Going back to our Windows environment, each component (perhaps a dialog box) has a container. Once again, Beans and containers (which could be Beans) are capable of such interactions, but there is no standard mechanism for doing so. The figure "Run-Time Arrangements" shows these two disparate relationships.

When a window is opened, the respective windowing API usually returns a handle or a descriptor for the window. This lets subsequent operations be performed on that window. This handle—called a BeanContext in Glasgow terminology—can manage the relationship between a Bean and its containing environment, or other Beans.

To accommodate the hierarchical structure required by BeanContexts, Glasgow defines other interfaces, `java.beans.BeanContextChild` and `java.util.Collection`, which provide the means to manipulate a Bean by adding children to it or to traverse through its hierarchy.


Run-Time Arrangements
Beans can query the environment to discover what services are available.
Services
Services
JavaBean
JavaBean
BeanContext
BeanContext
Java VM
Current JavaBeans implementation
JavaBean
JavaBean
JavaBean
JavaBean
BeanContext
BeanContext
BeanContext
Beans can "listen" for changes from "source" Beans.
Java VM
Glasgow implementation
New interfaces define child objects and their hierarchy.

Glasgow establishes a hierarchy among Beans, so that events and data progress to the appropriate component.

The interaction among Beans—or, more appropriately, BeanContexts—is based on a scheme similar to the new event model introduced in the Java Development Kit (JDK) 1.1. The model describes interactions in terms of listeners and sources. A BeanContext interested in another BeanContext first registers itself as a listener, and subsequently it's notified of changes by the source BeanContext.

In actual implementation, BeanContext is basically an interface. It defines not only hierarchical information, but also methods for service discovery and provider facility. A Bean uses the `hasService()` and `getService()` methods to ask a BeanContext about its services and uses them when appropriate. These methods also let JavaBeans learn about the operating environment and take advantage of any services the environment already provides.

Handling Data

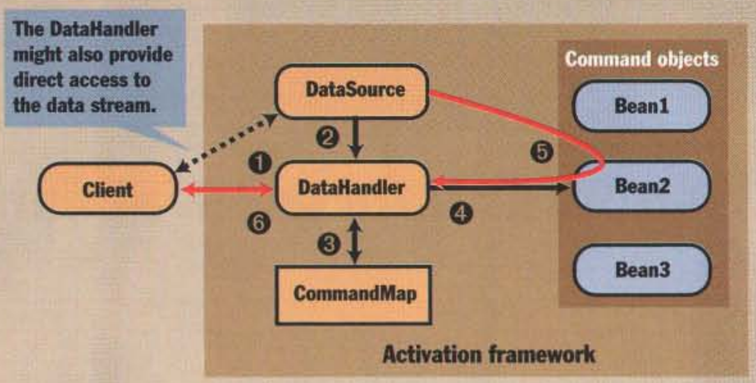
The second part of Glasgow is the JavaBeans activation framework. In principle, it is similar to how helper applications in a browser work. When a browser receives a piece of data, it looks at the Multipurpose Internet Mail Extensions (MIME) type to determine the data's type. The MIME type was transmitted as part of the HTTP header. Once a browser determines the data type, it searches a table to see what helper application must be invoked to decode and display the data.

The activation framework brings this flexible capability to JavaBeans. The services provided are categorized into the following groups: the determination of of an arbitrary data type, the encapsulation of access to the data, the discovery of available operations on the data, and the instantiation of an object (Bean) that performs the desired operation on data.

A `DataHandler` is an object that acts as the main interface between an arbitrary piece of data and a client wishing to use the activation framework. A `DataSource` is an object that contains both the data and the MIME type of the data. A `CommandMap` is a mapping between the operations available on a data type and a series of `CommandObjects` that implement the operations.

The figure "Dealing with Data" shows a typical usage scenario. A client object has a piece of data (the `DataSource`), and it uses the activation framework to determine what to do with that data.

Dealing with Data



❶ Client requests data through the framework interface.

❷ DataHandler uses information encapsulated in the DataSource object to determine the data type.

❸ By request of the client, the DataHandler searches the CommandMap for a Command object (Bean) that can process the data.

❹ The DataHandler invokes the proper Bean.

❺ The Bean obtains the data from the DataSource, processes it, and returns it to the DataHandler.

❻ The data is forwarded to the client.

The activation framework lets objects transparently recognize and process data.

Drag and Drop

The last part of Glasgow introduces a drag-and-drop (D&D) subsystem, something long desired by GUI developers. Enhancements to the Java Foundation Classes (JFC) provide a standard method for performing D&D in the Java environment. This lets Bean-based applications integrate nicely into environments where D&D operations are supported. For example, you could drop an object from OpenLook into a Bean.

The D&D mechanism is an extension of the Uniform Data Transfer Mechanism introduced in JDK 1.1. Its goals are twofold. The first is to keep the implementation platform-independent. This is possible because the mechanism uses the Abstract Window Toolkit (AWT) and JFC, which are already standardized among different Java implementations. The second goal is to provide integration with platform-dependent D&D facilities. For example, this means potentially you could drag and drop an OLE object onto a Bean as if it were a native OLE object.

All D&D operations can be managed based on a series of distinct states of the objects involved. A single Drag Source and one or more Drop Targets must exist, and all could be Beans. The usage of terminology such as Drag Source and Drop Target points to a familiar naming convention associated with the new event model in JDK 1.1.

In fact, the D&D operation is very similar to what happens during an event. The `DragSource` class defines the responsibilities of the source (the object initiating the operation). `DropTarget` does the same for the recipient object of the operation. Both objects also have a listener piece (`DragSourceListener` and `DropTargetListener`) that listens to events fired by their counterpart object. Collectively, these components are able to complete the D&D operation in a standard platform-independent manner.

While Glasgow consists of only three enhancements to JavaBeans, they are very significant ones. The run-time extensions allow the construction of hierarchies of objects, which is crucial in forwarding application events. The activation framework provides an infrastructure where Beans—and future applications—can transparently handle diverse types of data. Last but not least, D&D lets users simply drag information around the screen, wherever they need it. **B**

Piroz Mohseni is coauthor of JavaBeans Developer's Guide *(M&T Books, 1997). You can reach him at* **mohseni@iname.com.**

Compared to other remote-procedure-call mechanisms, RMI offers new features, thanks to tight integration with Java. ***By Paul Clip***

Java's Object-Oriented Communications

Java's remote method invocation (RMI), introduced in the Java Development Kit (JDK) 1.1, is a powerful mechanism that enables flexible and scalable distributed communications among Java programs. Last month I covered the ins and outs of IIOP, the Internet Interoperable-ORB Protocol that CORBA object request brokers use to communicate with each other. This month I focus on RMI, paying particular attention to Java's Remote Method Protocol (JRMP), its closest equivalent to IIOP.

Unlike CORBA, which is a programming-language-neutral architecture, RMI is designed exclusively for Java. Created by JavaSoft, its aim is to let Java programs invoke remote methods in a simple and natural way while ensuring it remains powerful enough to handle complex distributed systems. In addition to passing object data back and forth between clients and servers, RMI can pass object implementations across system boundaries. Thus, a server can send an object for client-side execution, and a client, perhaps wishing to take advantage of greater computing power, can upload objects to a server for execution.

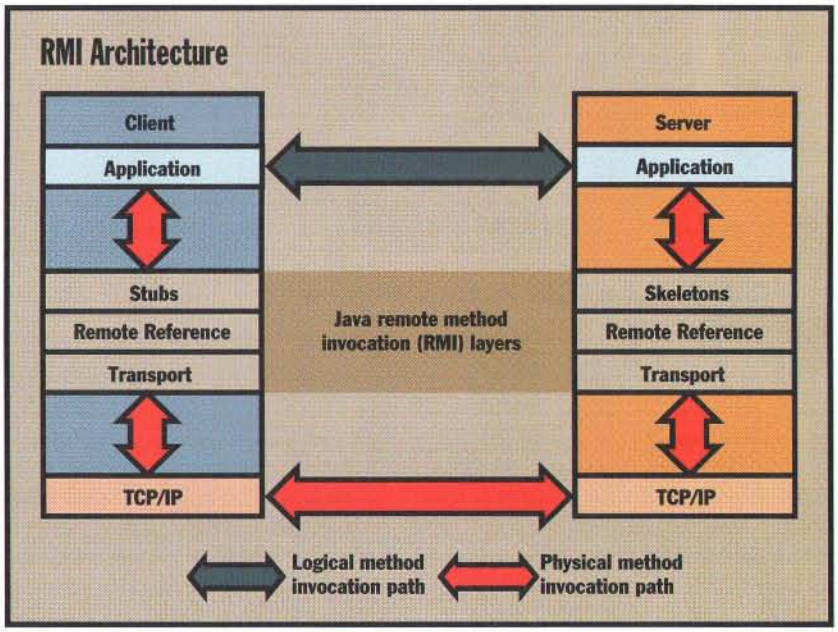
But RMI has more feathers in its cap: It sports a distributed garbage collector, preserves Java's strong security features, and takes advantage of Java's multithreaded nature for the enhanced concurrent processing of requests. Furthermore, it makes good use of Java's Object Serialization to send objects across systems without resorting to more complex encoding schemes, as found in CORBA.

The RMI Layers

The figure above shows RMI's layered structure. An invocation appears to travel between client and server, but in reality it passes through the RMI "stack" on both systems. All remote objects (i.e., objects whose methods can be remotely invoked) are represented by stubs on the client side and by skeletons on the server side. As with other remote-procedure-call (RPC) systems, this layer is responsible for marshaling method arguments and return values into a format suitable for sending between systems. For RMI, that format is Object Serialization. Only remote objects are passed by reference; all other objects are passed by copy.

The Remote Reference layer handles the behavior of remote objects and manages the Transport layer. Its task is to provide various types of method invocation, relieving stubs and skeletons from dealing with these complexities. The only type that is currently provided is point-to-point, where one object invokes another's method.

The Transport layer deals directly with the network protocols that provide the actual communications mechanism between systems. This layer sets up, manages, and monitors connections, including listening for and initiating them.



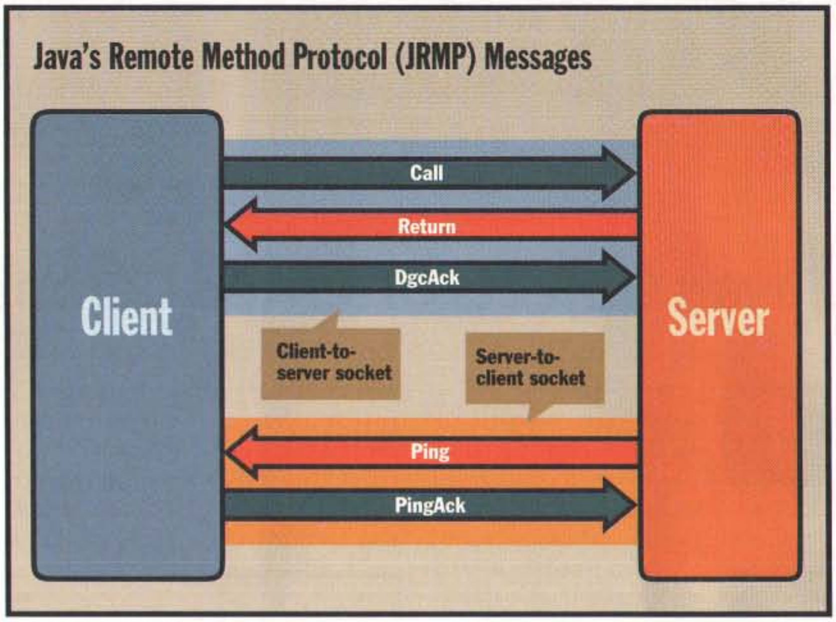
The RMI layers abstract invocation calls, hiding the low-level transport mechanism.

A big difference between RMI and other RPC systems is *dynamic class loading*. This mechanism lets clients and servers load classes over a network during run time. Dynamic class loading downloads not only remote object classes but also stubs, skeletons, and classes used as parameters, as well as return values in remote method invocations. For example, when a client receives an object of a class for which it has no implementation, it can download the class's bytecodes dynamically (typically from the same server).

Since security is a major concern, RMI uses the stringent applet security manager restrictions for RMI-enabled applets and provides its own security manager for applications. If no security manager is defined, RMI does not load classes from network sources at all.

Garbage collection, and freedom from the memory-allocation woes that it provides, is one of Java's strengths. RMI implements a distributed reference-counting garbage collector to keep track of remote objects. As the first reference to a remote object enters a system, a call is made back to that object's server to indicate that the object is in use, or *referenced*. When the last reference to the object is discarded, an *unreferenced* message is sent to the server, which can then safely garbage-collect the object (assuming there are no other outstanding references to it).

To deal with problems such as crashed clients and network partitions, each remote object is "leased" by clients from its server. Clients must periodically renew their leases with a server, which might otherwise assume that a client is no longer using an object.



JRMP enables bidirectional communications between client and server.

JRMP

The Transport layer employs JRMP, also known as the RMI Wire Protocol, to send method invocations and associated parameters and to return values and exceptions from one Java virtual machine (JVM) to another. JRMP is a simple protocol consisting of five messages, plus an extra five for multiplexing flow control.

All JRMP sessions consist of a header followed by one or more messages. The header contains just the ASCII codes for the characters *JRMI*, the protocol version, and the "subprotocol" to be used. There are three subprotocols: `SingleOpProtocol`, `StreamProtocol`, and `MultiplexProtocol`. `SingleOpProtocol` signifies that only one message follows a header before the end of a session (i.e., the connection closes). `StreamProtocol` and `MultiplexProtocol` can transfer one or more messages. The latter is used when multiplexing calls from both client and server on a single socket, as described below.

Communicating clients and servers typically each open a socket to the other (i.e., both systems connect and listen for connections). The client's socket typically invokes methods on server-side objects, and the server's socket calls client-side objects (e.g., callbacks). The figure above shows a hypothetical `StreamProtocol` situation. The client sends the `Call` message to invoke a server object's method; the server then invokes this method and replies with a `Return` containing any results. Assuming that a remote object is returned, the client then sends a `DgcAck` message to let the server's garbage collector know that it has received the remote object. On another socket, the server sends a `Ping` to find out whether the client is alive, which replies with a `PingAck`.

Default applet security restrictions deny applets the right to open sockets back to any server other than their originating host; they also block any attempt to listen for socket connections. This being the case, how do clients listen for server connections?

Enter the `MultiplexProtocol` and its group of five messages: `Open`, `Close`, `CloseAck`, `Request`, and `Transmit`. They allow client and server to simulate the `StreamProtocol`'s two-way communication using a single socket. In the current implementation, up to 256 virtual connections can be opened, each identified by a unique ID.

Unfortunately, connecting via a socket back to the server is not always possible for applets running behind firewalls (e.g., on a corporate intranet), which typically block any attempt to open a socket back to the Internet. Should it fail to open a connection, an RMI client wraps its method invocation inside the body of an HTTP request (which is the protocol browsers use to communicate with Web servers), and the RMI server sends any results as an HTTP response.

This workaround is a smart solution, since HTTP is a firewall-trusted protocol. Still, performance takes a hit due to the time needed to convert messages to HTTP requests. In addition, no multiplexing of invocations can be accomplished, because keeping the connection open between client and server is not part of HTTP 1.0. The primary reason for `SingleOpProtocol`'s existence is to encapsulate RMI through HTTP.

The Future of RMI

RMI extends Java's strengths into the realm of distributed systems. In the future, we can expect to see RMI offer replicated method invocation and possibly transport layers other than TCP/IP.

RMI has been criticized for its lack of interoperability with CORBA. To address this, JavaSoft is implementing a subset of RMI on top of IIOP, enabling Java programs to access CORBA objects via RMI. It's also working to incorporate RMI's features into IIOP. Maybe RMI will indeed become the future of object-oriented communications. **B**

Paul Clip is a Java-certified consultant working at Sapient Corp. in San Francisco. You can reach him at **paul@clip.org**.

Motorola's latest RISC processor is small, yet it delivers big computing power. ***By Bill Moyer and John Arends***

RISC Gets Small

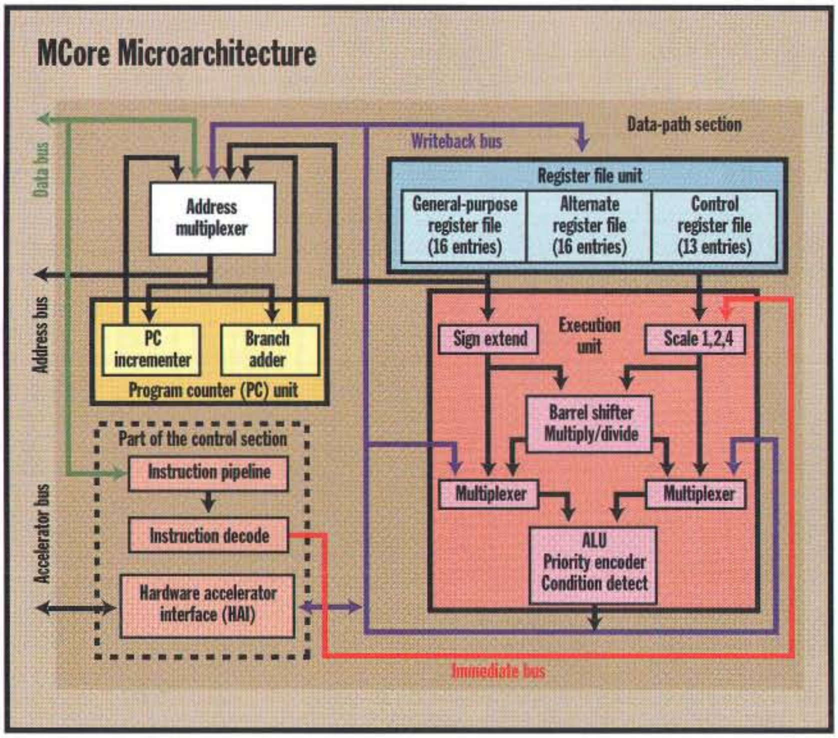
Battery life has become a major competitive force in handheld computing products, perhaps as important as a low weight and a small form factor. Motorola's newest 32-bit offering, the MCore RISC processor, targets cost-sensitive embedded control applications that demand high performance yet must consume little power. MCore processors minimize power consumption by combining a fully static CMOS design with low-voltage operation. Initial versions of the chip operate at 1.8 volts, feature several low-power operating modes, and provide dynamic power management. These capabilities make the MCore ideal for battery-operated portable products.

MCore's first production version is implemented in a 0.36-micron, triple-level-metal static CMOS process. The result is an 80,000-transistor CPU that occupies just 2.2 mm^2 of die. MCore products come in low-cost plastic ball grid array (PBGA) and thin quad flat pack (TQFP) versions that sport 100 to 200 pins, depending upon the application. The low pin count eliminates additional signal lines from a product's design, thereby reducing its size and cost.

Processor Architecture

The MCore processor core is divided into a data-path section and a control section. The data-path section consists of 50,000 transistors, while the control section uses the remaining 30,000 transistors for control circuitry and clocking. The data-path section consists of a program counter unit, an execution unit, a register file unit, a memory interface unit, and a hardware accelerator interface (HAI) unit, as shown in the figure "MCore Microarchitecture." The control section manages the overall sequencing and coordination of the execution units and interfaces. Additional logic in the data-path section minimizes power consumption by automatically powering down unused internal function units on a clock-by-clock basis. Doze, Wait, and Stop power-conservation modes provide comprehensive system power management.

MCore Microarchitecture

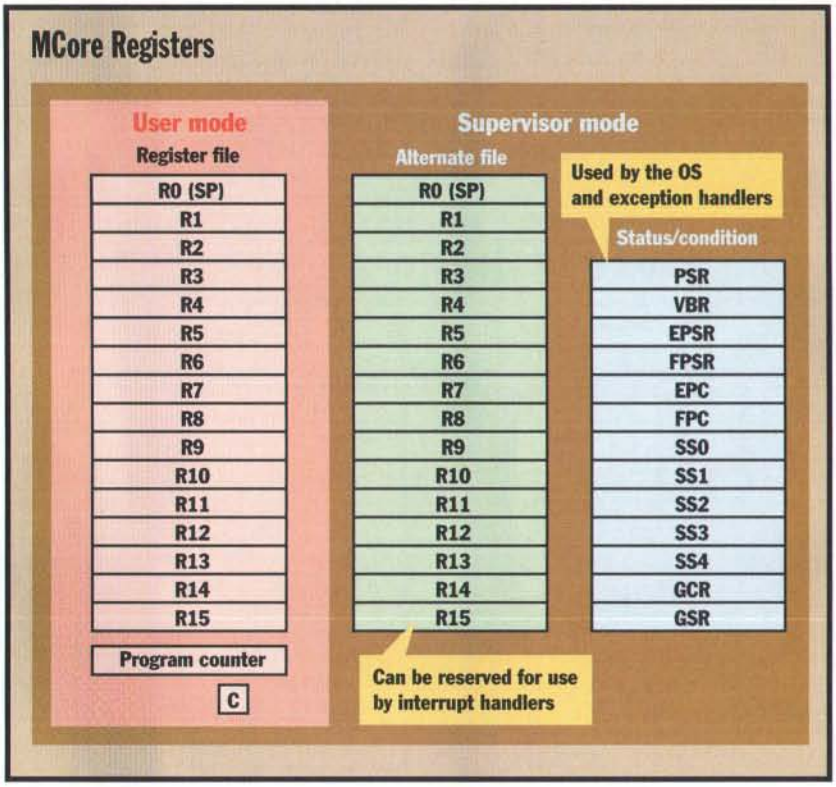


This processor offers performance features such as hardware multiply/divide and registers for low-latency interrupt handling.

The execution unit contains a 32-bit arithmetic logic unit (ALU), a 32-bit single-cycle barrel shifter, a multiply/divide unit, a find-first-one unit (a priority encoder), and result-feed-forward hardware. All arithmetic and logic operations execute in a single cycle. The exceptions to this rule are, of course, the multiply and divide operations. The multiply instructions use a modified Booth's algorithm with early-out capability that reduces execution time for operations with small multiplier values. The divide instructions also offer minimized execution timing.

The program counter unit has a dedicated program-counter incrementer and a dedicated branch address adder that minimize the execution time required to deal with a change in program flow. Branch target addresses are calculated in parallel with the branch instruction decode and branch condition checking. Thus, a conditional branch executes in only two clock cycles, while branches not taken execute in one.

Memory load and store operations execute in two clock cycles, where one cycle adds a scaled displacement to a base address pointer value and the second cycle performs the memory access. Load and Store Multiple Register instructions allow low-overhead register file save and restore operations. These instructions execute in (N+1) clock cycles, where *N* is the number of registers to transfer. The memory interface unit provides a full 32-bit address bus and a 32-bit data bus, along with access attribute indicators for transfer of instructions and data operands. The memory interface unit monitors these attributes along with the logical address to provide memory protection.



The alternate register file provides for low-overhead context switching in real-time processing.

MCore has sixteen 32-bit general-purpose registers. Programs operating in the chip's supervisor mode have access to a second set of sixteen 32-bit registers, which normally serves as an alternate register file. The register file unit contains both the 16-entry general register file and the alternate register file, plus 13 status/control registers available to supervisor software.

Throughput Optimization

System cost and power consumption are strongly affected by an application's memory requirements. While MCore is a 32-bit load/store RISC architecture, it adopts a compact 16-bit fixed-length instruction format. Benchmark results on a variety of application tasks indicate that the code density of MCore programs is higher than many CISC designs, in spite of the fixed-length instructions. The high code density lowers an embedded product's cost, since the most expensive parts of a design are memory. The 16-bit instructions also reduce the amount of fetch traffic on an external bus, further reducing power consumption. Finally, the instruction width keeps system performance high even when a design uses 16-bit memory to minimize costs.

For embedded applications that require real-time processing, MCore provides an exception mechanism that is both flexible and fast. Exception processing uses an exception vector table (a table of 32-bit pointers) and a set of internal shadow registers to transfer control to an exception handler. MCore uses a relocatable vector table that contains 128 exception vectors. For external devices that don't provide an interrupt vector, an autovector (default vector) capability is provided.

MCore processors support two independent interrupt requests: a normal interrupt and a higher-priority fast interrupt. The fast interrupt request uses a dedicated set of shadow registers that eliminates having to preserve the processor's context on the stack before the interrupt handler executes. Software can reserve the alternate register file for exclusive use by interrupt handlers. This enables support of extremely low-latency interrupts, and it makes real-time processing possible.

MCore's hardware accelerator interface supports tightly coupled hardware function blocks that extend the MCore architecture. For flexibility, the interface is generic in nature and makes few assumptions about the actual processing being accelerated. The HAI operates independently of the memory and peripheral interfaces to allow overlapped execution. A base set of instruction primitives allows the explicit transfer of operands and instructions to and from external function blocks. Hardware handshaking can control the rate of the instruction and data transfers. The function blocks are tailored to boost processing for application-specific purposes. For example, such a block might act as a DSP arithmetic unit or a graphics accelerator; another block might handle speech processing or handwriting recognition.

Small Die, Big Performance

Initial MCore processors use supply voltages ranging from 1.8 to 3.6 volts. The chips operate at 50 MHz. The "sedate" clock rate dramatically lowers power consumption—critical for a hand-held device. At 50 MHz, MCore delivers 48 Dhrystone 2.1 MIPS yet consumes only 20.5 milliwatts. The inexpensive packaging, support for 16-bit memory devices, and low power consumption, combined with high performance, make the MCore processors attractive for the cost-sensitive consumer and embedded-control markets. It also provides a migration path for existing 8-bit and 16-bit controller applications. ■

Bill Moyer (**billm@sandbox.sps.mot.com**) *is a principal architect and systems designer for Motorola. John Arends* (**john_arends@email.sps.mot.com**) *has worked on Motorola's RISC processor designs and implementations.*

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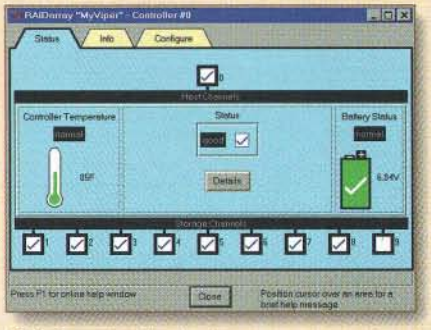

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A look at several basic tricks necessary to write application-caliber programs using JavaScript. ***By Bob Friesenhahn***

Writing JavaScript Applications

On September 12, 1997, an industry newspaper reported that Microsoft is giving Java applets "the boot" on its Web site. Clearly something is afoot at the company that cared enough about Java to write its own Java interpreter rather than use one licensed from Sun. Some reports have it that this "something" is JavaScript. For most Web browser uses, JavaScript loads faster, runs faster, and produces pages that are more "Web-like" than equivalent Java applets.

Traditionally, Java has been seen as the language for writing browser-based applications. However, JavaScript implementations have reached a level of sophistication and stability so that JavaScript can be used to write useful applications. Since JavaScript is much more closely wedded to the fabric of the browser, applications can be written in fewer lines of code. This smaller code footprint consumes less processing power and fewer network resources than Java.

JavaScript Basics

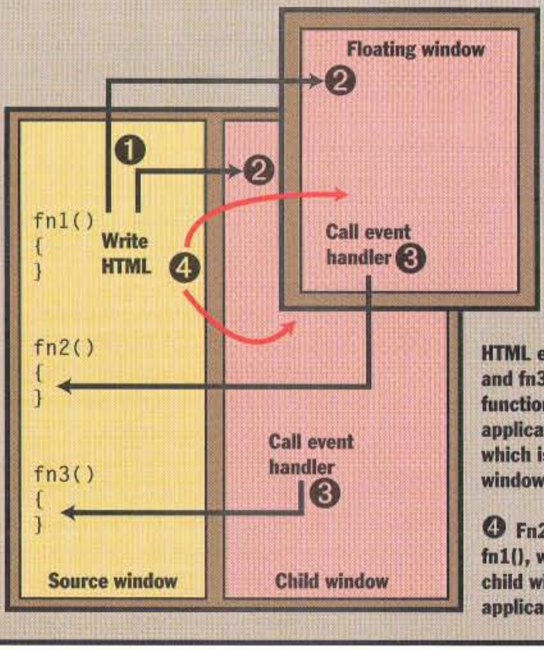
What is meant by the term "application?" For the purpose of this article, an application is code that executes in the client and enables calculation, presentation, manipulation, and saving of results (with minimal interaction) to a server. An application may manipulate complex data structures and display multiple screens of output without requesting new pages from the server.

JavaScript provides many capabilities that are useful to support browser-based applications. These include:

- general-purpose computations
- general-purpose data structures (strings, arrays, and hashes)
- dynamic HTML-based content generated on the fly
- data loaded as JavaScript
- interval timers

Note that JavaScript does not provide any support for graphics capabilities beyond those provided by HTML. This is a key point: JavaScript must leverage the capabilities of the browser and HTML to display content. Other than a few dialog-box functions, JavaScript provides no direct display capabilities.

Maintaining a JavaScript Application's State



❶ Function fn1() writes HTML into adjacent frame (child window) and floating window.

❷ The HTML written into these windows register fn2() and fn3() as event handlers.

❸ User interacts with HTML elements that cause fn2() and fn3() to be executed. These functions modify the application's internal state, which is stored in the source window.

❹ Fn2() and fn3() execute fn1(), which updates the two child windows to reflect the application's current state.

You can store application functions and preserve variables in a window with static content.

JavaScript is no panacea. It has characteristics that work against developing full-fledged applications. For example, it has severely limited communications (read-mostly) with a server and severely limited means of storage. Unlike most languages, there's no global variable and function namespace available. In addition, JavaScript relies on a complex browser object model, and there's no protection from external manipulation by the browser. Until recently, JavaScript lacked a standard, which resulted in some implementations of patchy quality. Fortunately, this is changing: The European Computer Manufacturers Association has developed a specification for JavaScript, known as ECMA-262 (or ECMAScript). For more information, you can download the standard at http://www.ecma.ch/.

Due to the limitations of JavaScript, developing a JavaScript-based application is like preparing for battle. The developer must be aware of JavaScript's strengths, as well as its weaknesses. He must also know the environment in which the application will be used. The first step in developing a JavaScript application is to identify who will be using it. The users must be running browsers that support a reasonably current version (at least 1.1) of JavaScript. It is unwise to completely abandon the (usually vocal) minority in favor of the majority. While JavaScript can improve performance and access for browsers that support it, some other means (e.g., HTML pages or a CGI script) should be made available to support less capable browsers. Careful use of <SCRIPT> tags and the `window.location.href` property can shunt JavaScript users to special pages just for them while providing existing HTML pages for other people.

Three Ways to Slice It

JavaScript applications depend on dynamically generating HTML. The following code fragments illustrate three different ways to write HTML from a window named "main" to an adjacent window named "output." The function `Text()` **below returns the desired HTML.**

```
function Text() {
 var htmlText =
  '<HTML><HEAD>\n' +
  '<TITLE>Hello World</TITLE><HEAD>\n' +
  '<BODY><H1>Hello World</H1></BODY>\n' +
  '</HTML>\n';
 return htmlText;
}
```

First method: Open and write to window directly.

```
parent.output.document.open('text/html');
parent.output.document.write(Text());
parent.output.document.close();
```

Second method: Open window and write to its document object.

```
var out = window.open(", 'output');
out.document.write(Text());
out.document.close();
```

Third method: Open window using a JavaScript URL.

```
window.open('javascript:parent.main.Text();',
  'output');
```

Window Tricks

As mentioned earlier, JavaScript associates variables and functions with the windows they are defined in. There are no global variables in JavaScript. If the HTML in a window reloads, all the preexisting variables and functions in that window get erased. This effect is the single greatest hurdle to overcome in order to move JavaScript beyond simple dynamic pages into the realm of a full-fledged application. The key is to create a window that remains constant throughout the application's lifetime. You do this by defining a window with static content (and that can't be resized) or by creating a (usually) hidden zero-size window. Place all variables and functions that define the core of your application in this stable window, as shown in "Maintaining a JavaScript Application's State."

Since your application is subject to the whim of the user, make sure that the window you choose for storage won't be deleted by making it obvious that this is the application's main window. Ensure that your JavaScript application handles unexpected events properly. If multiple windows are in use, supply a `window.onUnload()` handler that closes any child windows if the user does the unthinkable and deletes the main window. Since windows can be loaded in any order, and the user might start using windows before they (or windows they depend on) are fully loaded, consider adding an `onLoad` handler to FRAMESET definitions to let you know when all windows have been loaded. Practice defensive coding by testing to verify that windows, frames, variables, and functions exist before attempting to use them. It is usually best to ignore inputs until all the windows of the application are loaded and initialized.

JavaScript has a severe limitation: It can load data only by loading a URL into a window. At first glance, this would seem to make JavaScript totally unsuitable for writing any kind of application. However, the URL that loads can contain JavaScript that defines things such as simple variables, arrays, and hashes. Once these variables load into a window, they can be accessed by other windows. Browsers that support JavaScript 1.1 or later can load JavaScript source files directly via the syntax `<SCRIPT LANGUAGE="JavaScript1.1" SRC="data.js">`. Multiple statements of this kind can occur in a single HTML file. The effect is additive, so one source file may define JavaScript functions, while other source files define data. If the data the application requires is static, it may be loaded from a pregenerated HTML file. If the data is dynamic, the referenced URL can be a CGI script that returns data (and possibly additional functions) formatted as JavaScript source code.

Cookies and Forms

The only means that JavaScript has for saving state are local JavaScript cookies and HTML form submissions. Cookies are best used for keeping track of user information between sessions. Forms are best for submitting final data to a CGI application on the server where results are stored. If you want to add Java to the mix, versions of Netscape Communicator 3.0 or later support the ability to communicate between JavaScript and Java. Since Java communicates efficiently with the server, it can be used as a bridge between JavaScript and the server.

JavaScript is a complex language that you cannot learn in one sitting. As the inventor of JavaScript, Netscape is the authority on JavaScript syntax. The company maintains JavaScript documentation on its developer support site at http://developer.netscape.com. A book I have found to be an outstanding reference is David Flanagan's *JavaScript: The Definitive Guide, 2nd Edition,* published by O'Reilly & Associates. **B**

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*Bob Friesenhahn (***bfriesen@simple.dallas.tx.us***), a frequent contributor to BYTE, specializes in Unix and TCP/IP networking topics.*

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DISPOSABLE PCs

New technology, fragmenting standards, and a revolt against rapid obsolescence will radically change the PC landscape over the next two years. Are you ready?

By Tom R. Halfhill

The old vision that disparate computer and medium technologies would converge on a single platform is fading fast. Features are converging, but existing platforms can't stand the strain. They're splintering into new platforms and subplatforms to satisfy an exploding computer market that's extending its reach from TV Internet terminals and $300 Windows PCs to 64-bit workstations and enterprise servers. One-size-fits-all PCs can't cut it anymore.

The dominant standard that we've taken for granted for a dozen years, the x86-based PC clone, is showing clear signs of these fractures. It's becoming a victim of corporate rivalries and a strange technological paradox—hobbled by too much old technology to keep up with new technology, and swamped by too much new technology to justify large investments in current technology.

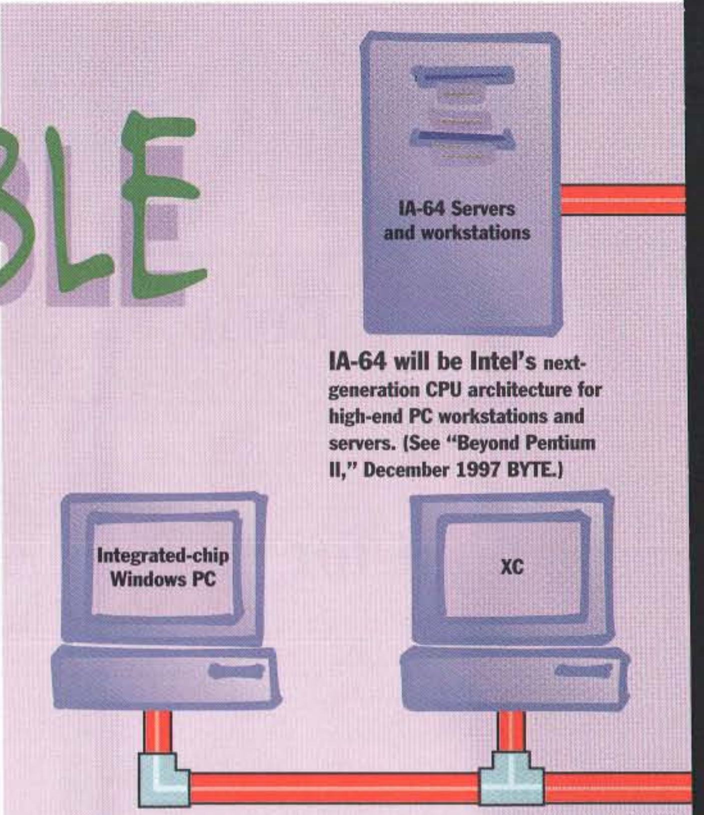
In its place, a looser, more stratified PC "standard" will maintain a semblance of software compatibility while addressing a much broader range of users. And users who are overwhelmed by all these changes are beginning to revolt by spending less on computers that they know will be instantly obsolete.

Some market watchers think this trend is the inevitable culmination of the PC's success. "What you're calling platform fragmentation is what I call market segmentation," says Steve Tobak, vice president of corporate marketing at Cyrix. "Did anybody really think that when PC volumes climbed to 100 million that there would be only one kind of PC?"

Four Layers

Here's how the new world order will look:

❑ IA-64 will be the next-generation CPU architecture for high-end Windows workstations and servers. And the first



IA-64 will be Intel's next-generation CPU architecture for high-end PC workstations and servers. (See "Beyond Pentium II," December 1997 BYTE.)

Highly integrated CPUs based on x86-compatible cores are ideal for low-end home and office PCs. Today, you can buy a Windows PC (without a monitor) for $499; in a few months, they'll drop to $299. (See the text box "System On A Chip" on page 64.)

"XC" is an umbrella term for low-cost, specialized PCs. Acer is planning to introduce a series of XCs, including a KC (Kid's Computer), a GC (Games Computer), an INC (Internet Computer), an HBC (Home Banking Computer), and an STC (TV Set-Top Computer). Prices: $200 to $500.

Technology Time Line 1997

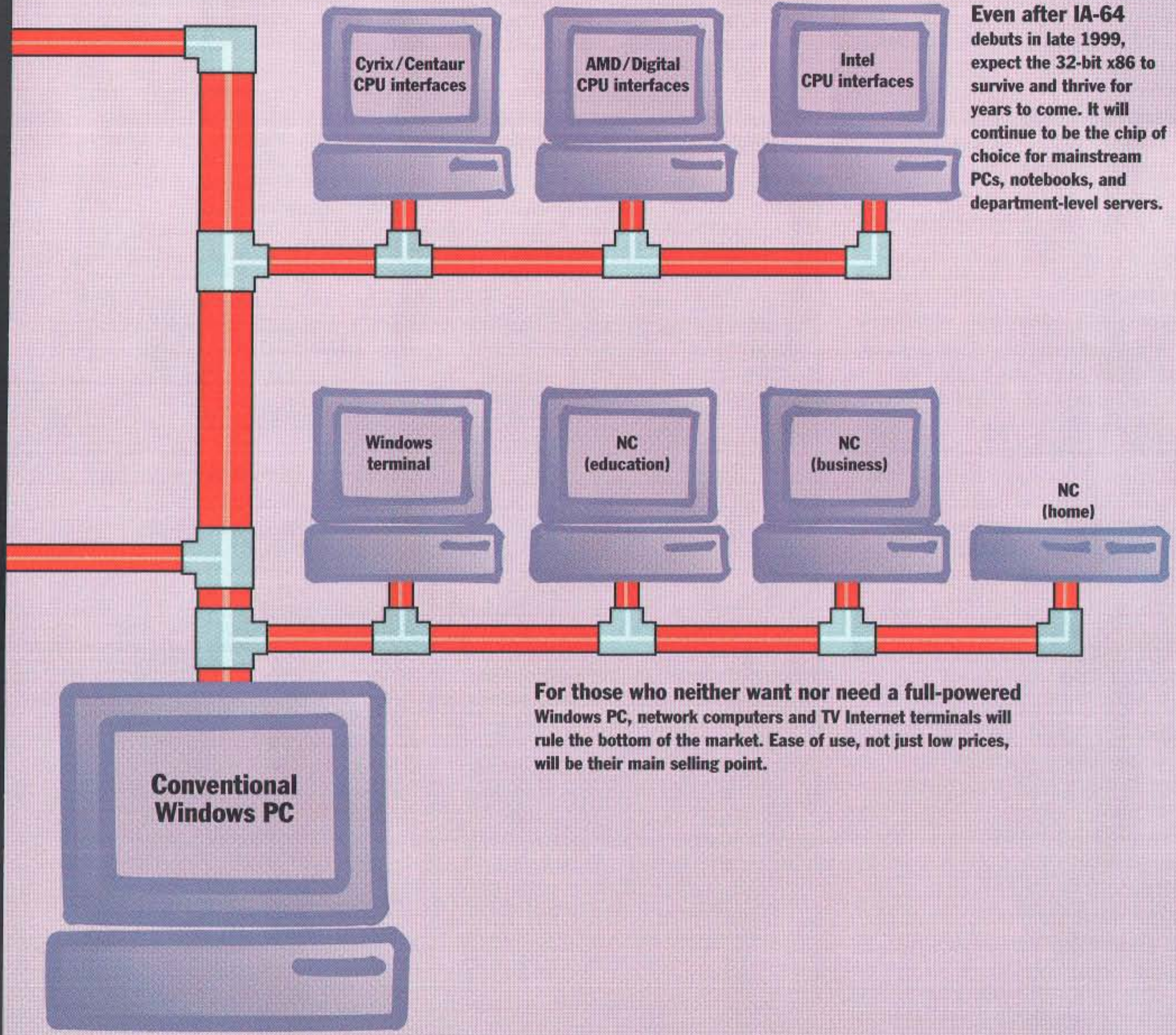
Fading Technologies

- 586-class CPUs (non-MMX)
- CPUs < 166 MHz
- RAM < 16 MB
- FPM-DRAM
- ISA

Hot Technologies

- 586-class CPUs (MMX)
- SDRAM
- EDO DRAM
- USB
- 1394 FireWire

The New World Order



Even after IA-64 debuts in late 1999, expect the 32-bit x86 to survive and thrive for years to come. It will continue to be the chip of choice for mainstream PCs, notebooks, and department-level servers.

For those who neither want nor need a full-powered Windows PC, network computers and TV Internet terminals will rule the bottom of the market. Ease of use, not just low prices, will be their main selling point.

1998

- 586-class CPUs (MMX)
- EDO DRAM
- Socket 7
- 66-MHz CPU bus

- CPUs < 200 MHz
- RAM < 32 MB
- ISA

- Pentium II (Deschutes)
- Intel Slot 2
- AGP-2x
- x86 3-D extensions
- 100-MHz CPU Bus

1999

- AGP-2x
- SDRAM
- Socket 7

- CPUs < 300 MHz
- RAM < 64 MB
- Serial and parallel ports
- ISA

- IA-64 (Merced)
- Pentium II (Katmai-MMX2)
- AMD Slot A
- AGP-4x
- RDRAM

2000

- CPUs < 500 MHz
- RAM < 128 MB

- IA-64 (Merced+)

implementation will be Intel's 64-bit Merced processor, scheduled to debut in late 1999. But IA-64 won't replace the 32-bit x86 architecture for a long while. (See "Beyond Pentium II" in the December 1997 BYTE.)

☐ The x86-based PCs will continue to thrive well into the first decade of the twenty-first century as the mainstream architecture for desktop PCs, notebook computers, and department-level servers. Intel and other x86 vendors will continue to introduce new designs for years to come, even after the debut of IA-64.

☐ Super-integrated CPUs built around x86-compatible cores will address the low end of the market for Windows PCs in homes and businesses. The leading example today is Cyrix's MediaGX, which integrates the functions of a CPU and several motherboard devices on a pair of low-cost chips (see the text box "System On a Chip"). The MediaGX powers a new breed of affordable PCs priced from $499 to $999. Later this year, prices will drop to an unbelievable $299.

☐ TV Internet terminals will anchor the bottom end of the market for consumers who don't need or can't fathom a full-blown Windows PC. This segment got a big boost when Microsoft reversed its opposition to network computers (NCs) and bought WebTV Networks. Although it will take a while to establish these novel devices in the technology-resistant consumer market, they will eventually be a popular alternative to overcomplicated PCs.

The new stratification doesn't end there. It will span multiple technical standards as well as market segments. Whether you call it fragmentation or segmentation, it's not like yesterday's comfortable PC environment, in which all PC clones were basically the same except for their degrees of megahertz and megabytes. The fault lines separating the new layers will run as deep as the OSes, the motherboards, and the microprocessor chips.

System On a Chip

The key to inexpensive Windows PCs is higher integration, and Cyrix is leading the way. Its MediaGX processor delivers Pentium-class integer performance while integrating the functions of an SVGA graphics card, a DRAM controller, a PCI controller, and other parts of the system core logic. A companion chip, the Cx5510, emulates a 16-bit Sound Blaster while bridging to the ISA bus, a two-channel IDE bus, and other system devices (see the figure "MediaGX Architecture").

When paired together, these chips enable very-low-cost PCs. For one thing, the system doesn't need a dedicated frame buffer, because the MediaGX uses about 2 MB of main memory for graphics. Usually, a unified memory architecture degrades performance by 10 percent to 15 percent. But because the MediaGX integrates the graphics controller with the CPU, graphics data doesn't flow over a 32-bit, 33-MHz PCI bus. Instead, the data travels between the CPU and the graphics controller over a 64-bit internal bus clocked at the core frequency. The chip also compresses the graphics data on the fly to reduce bus traffic.

Similarly, the MediaGX does without a Level 2 (L2) cache. The integrated memory controller communicates with the CPU core over the internal bus, slashing the time required for memory accesses. Although the chip might run a little faster with a cache, the difference isn't great enough to justify the extra cost in a low-end system. The MediaGX does have a unified 16-KB Level 1 (L1) cache, and it supports extended data out (EDO) RAM expansion to 128 MB.

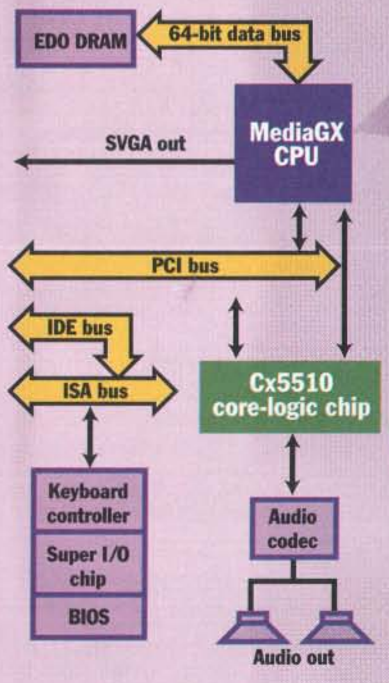
When Cyrix began shipping the MediaGX in late 1996, the core speed was 133 MHz. Since then, Cyrix has introduced versions that run at 150 and 166 MHz, with a 200-MHz chip due soon. These cores don't support MMX and have relatively poor floating-point performance, but they can match or beat the Pentium when running common integer-intensive applications.

In the second half of this year, Cyrix plans to introduce a next-generation integrated chip known as the MXi. It's built around Cyrix's Cayenne core, which has a 64-KB L1 cache, a superscalar FPU, MMX support, improved integer units, and 15 new instructions for speeding up 3-D graphics (see "Beyond MMX," December 1997 BYTE). The MXi will also integrate the Accelerated Graphics Port (AGP), digital versatile disc (DVD) playback, and a synchronous DRAM (SDRAM) controller. Cyrix claims that the MXi will match the performance of Pentium II processors running at 300 to 400 MHz, and that the integrated 3-D graphics controller will render more than 2 million pixels per second.

National Semiconductor's recent acquisition of Cyrix opens the door to even higher levels of integration in the future. National is a leading supplier of the Super I/O chips that control keyboards, mice, I/O ports, and other motherboard interfaces. As far as is known, no other vendor of x86 chips is pursuing such high levels of integration with the latest CPU cores.

MediaGX Architecture

Cyrix's MediaGX consists of two highly integrated chips: the MediaGX CPU and the Cx5510.



Splintering Platforms

By the end of this year, for example, there will be seven not-fully-compatible versions of Windows in wide use, each with an installed base in the millions: Windows CE, Windows 3.1, Windows 95, Windows 98, Windows NT 3.51, Windows NT 4.0, and Windows NT 5.0. Each upgrade maroons another island of users who don't have the hardware or the desire to keep up. Meanwhile, Microsoft struggles to unify the driver models, user interfaces, feature sets, and APIs for all those variations of Windows.

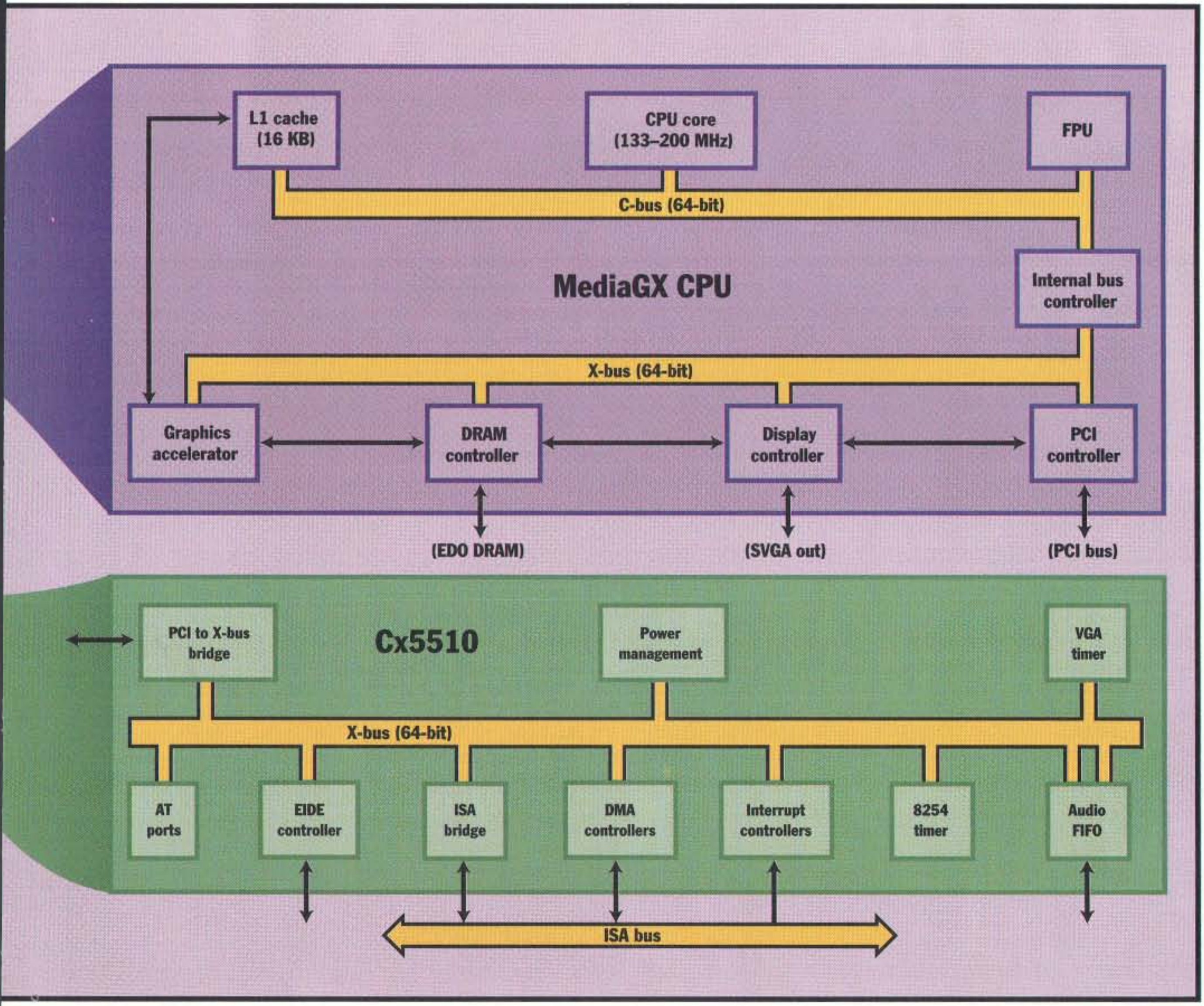
Microsoft's well-publicized plan is to eventually converge the PC platform on Windows NT, with Windows CE as the scaled-down solution for palmtop computers, WebTV boxes, and other alternative devices. But to paraphrase an old Army joke, that would leave Microsoft with only two sizes: too large and too small.

The increasing segmentation of PC hardware will probably force Microsoft to abandon its grand unification theory and continue to offer one or possibly more medium-size choices. Unless Microsoft manages that process uncommonly well, it will fracture the PC platform still further. Someday, you might need Java just to write a program that runs on every version of Windows.

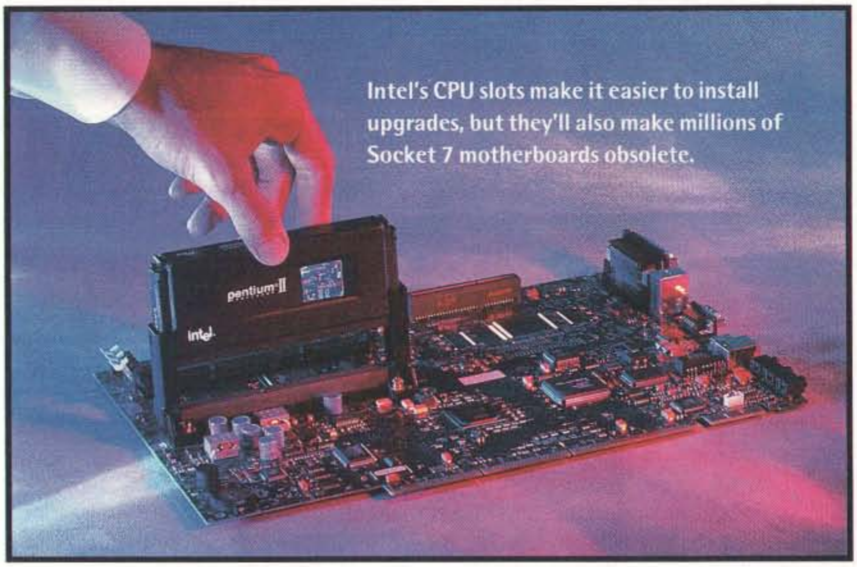
Meanwhile, outside the world of Windows, there are still tens of millions of users who think the idea of a one-size-fits-all OS is as quaint as a one-size-fits-all PC. Contrary to shortsighted beliefs, there will always be alternative platforms such as Java, Linux, Unix, the Mac OS, OS/2, BeOS, and Rhapsody. If Microsoft stubbornly pushes its plan for convergence on Windows NT, one of these upstarts will fill the gap.

Drilling deeper, down to the motherboard and microprocessor levels, even more cracks are appearing in the PC platform. The leading vendors of x86 processors are introducing mutually incompatible CPU interfaces to replace today's standard Socket 7 (see the text box "The Slot Thickens" on page 66). To accelerate multimedia performance, they are also promoting mutually incompatible extensions to the standard x86 architecture. (See "Beyond MMX" in the December 1997 BYTE.) Both of these fundamental changes will lead to more diversity in processors, motherboards, and chip sets—and more hazards to compatibility.

As if all that weren't enough, there's also an alphabet soup of new technologies intended to completely overhaul today's PCs: 100-MHz system buses, the Accelerated Graphics Port (AGP), AGP-2x, AGP-4x, synchronous DRAM (SDRAM), Double Data Rate SDRAM (DDR-SDRAM), Rambus DRAM (RDRAM), DVD-ROM (digital versatile disc), DVD-RAM, the Device Bay



interface, MMX2, the slow eclipse of ISA, faster/wider PCI, ISO-1394 FireWire, universal serial bus (USB), Fast Ethernet, the Advanced Configuration and Power Interface (ACPI), Ultra DMA, Ultra 2 SCSI ... and more ... and more.


Intel's CPU slots make it easier to install upgrades, but they'll also make millions of Socket 7 motherboards obsolete.

Users Revolt

There's growing evidence that computer buyers, both consumer and corporate, are reacting to the uncertainty over these changes. Although they're buying more computers than ever before, they're spending less money on each computer—often, much less.

According to market researchers at Computer Intelligence (La Jolla, CA), about 70 percent of the PCs sold through U.S. retail stores in recent months cost less than $1500. Even more remarkable, 30 percent to 40 percent cost less than $1000. A year ago, only about 5 percent of PCs cost less than $1000. What was once an insignificant crumb has suddenly become the whole cake.

In the dealer channels that serve mainly corporate buyers, average prices are a little higher—but still, a third of these PCs sold in recent months cost less than $1500. In December, Hewlett-Packard introduced a Vectra-series PC for the corporate market at a base price of $999.

Of course, everyone likes a bargain. But in the past, users resisted low-priced PCs because they feared the machines would become obsolete too quickly. Now they're resisting high-priced PCs because they fear those machines will become obsolete too quickly.

"People have fought this fear of obsolescence for a long time, and they've given up," says Matt Sargent, an analyst at Computer Intelligence. "No matter what kind of PC they buy, it's going to be obsolete in two years anyway. So they'd rather spend less on the PC and replace it more often."

This signals a major upheaval in PC purchasing habits. For years, the standard computer-magazine advice has been to buy the most powerful PC you can afford as

The Slot Thickens

Jerry Sanders, founder and CEO of Advanced Micro Devices, dropped a bombshell during his keynote speech at the recent Microprocessor Forum: In 1999, AMD's future K7 processor will come in a cartridge that's physically compatible with Intel's proprietary Slot 1. But AMD's new CPU interface, tentatively dubbed Slot A, won't be electrically compatible with Slot 1.

Before the audience of stunned engineers could digest that information, Sanders continued. The K7 will abandon the x86-standard Socket 7 bus in favor of the I/O bus on Digital Equipment's Alpha 21264 processor. And to wrap up the surprise, Sanders added that future 21264 chips will adopt the same cartridge and will work interchangeably with K7 cartridges on Slot A motherboards.

Even Digital was caught off-guard. Although Digital and AMD had worked out the deal, Digital didn't know Sanders was going public so soon. Sanders probably wanted to launch a preemptive strike against the growing speculation that AMD wasn't prepared for life after Socket 7. The new alliance with Digital will bring a blazingly fast I/O interface to AMD's processors while opening up a larger market of commodity-priced motherboards to Digital's RISC chips.

AMD had to do something, because Intel's P6-series processors (the Pentium Pro and the Pentium II) introduced a proprietary CPU interface that's protected by numerous patents. Cloning it is technically easy, but it's legally difficult. And even if the patents did not exist, AMD is forbidden to clone the P6 interface by a 1996 settlement ending a long-running court battle over Intel's intellectual property.

Intel's P6 interface takes several physical forms, all adhering to the same electrical-bus protocol. Pentium Pro chips use Socket 8. Pentium II chips come in a Single Edge Contact (SEC) cartridge that fits Slot 1, Slot 2, or a smaller slot for notebook computers. The SEC cartridge is really an enclosed daughterboard with a heat sink that slides down through a pair of vertical channels into a slot on the motherboard (see the above photo).

The P6 interface has a 64-bit-wide system bus that runs at 66 MHz, which will soon increase to 100 MHz when Intel releases the 440BX chip set. It also has a separate 64-bit-wide back-side bus for the Level 2 (L2) cache.

In Slot 1 systems, the back-side bus typically runs at half the frequency of the CPU core. In Slot 2 systems, it can run as fast as the core (333 MHz and higher with Deschutes).

Because Intel isn't licensing the P6 interface to competitors who make x86-compatible processors, nobody else can make chips that work on the same motherboards as Intel's processors. That's a big change from Socket 7, which any vendor can use.

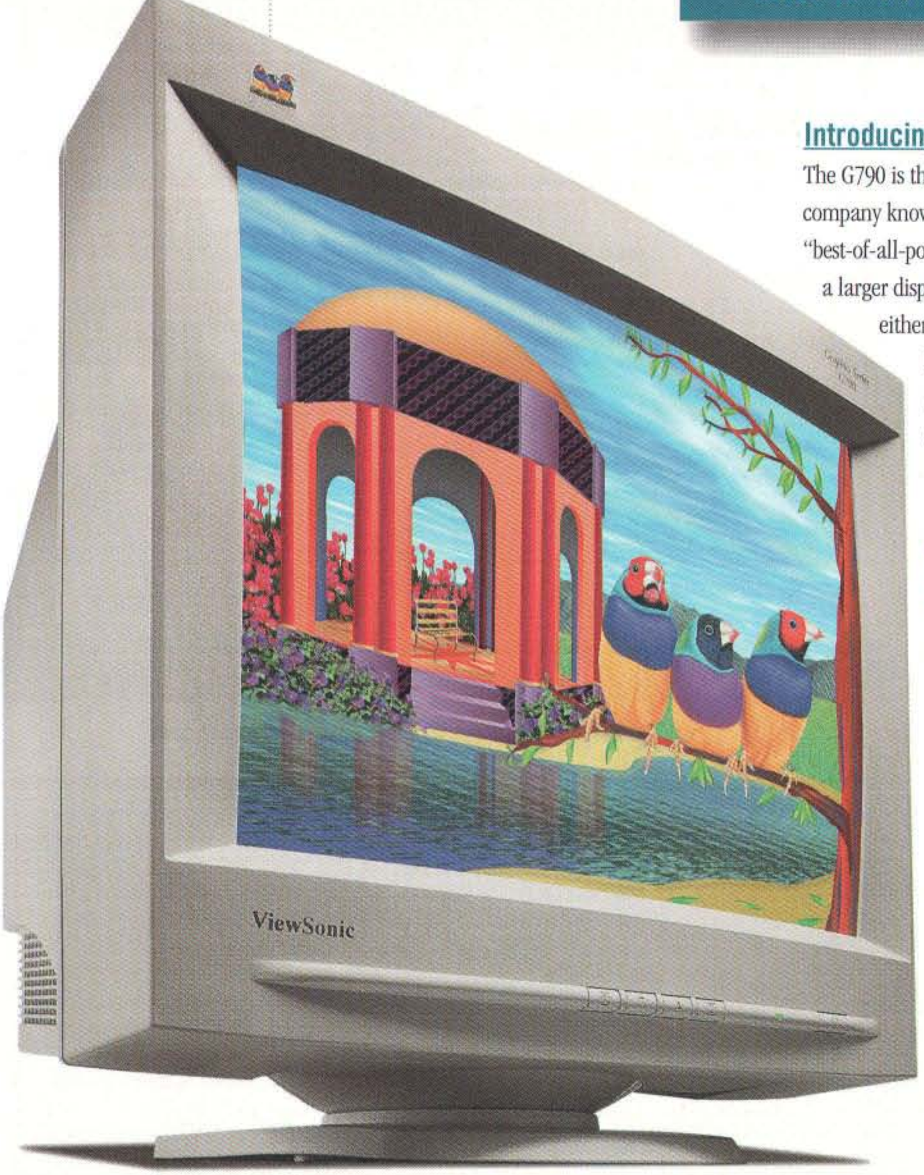
However, Intel's patents cover only the P6-bus protocol, not the physical cartridges or connectors. Those parts are available from multiple suppliers. AMD's plan is to leverage the growing infrastructure for the parts by introducing a CPU interface that's physically compatible. It's less costly than inventing a new interface and lobbying suppliers to support it.

Also, Slot A motherboards would be very similar to Slot 1 motherboards, requiring only a different core-logic system chip set and some minor layout changes. That would make life easier for motherboard manufacturers.

(Actually, Slot A probably won't be exactly the same as Slot 1. To prevent accidental damage to motherboards and CPUs, Slot A will almost certainly be keyed in a slightly different way so users can't insert an Intel cartridge into AMD's slot or vice versa.)

AMD needed a next-generation

For people with 19-inch eyeballs and a 17-inch work space.



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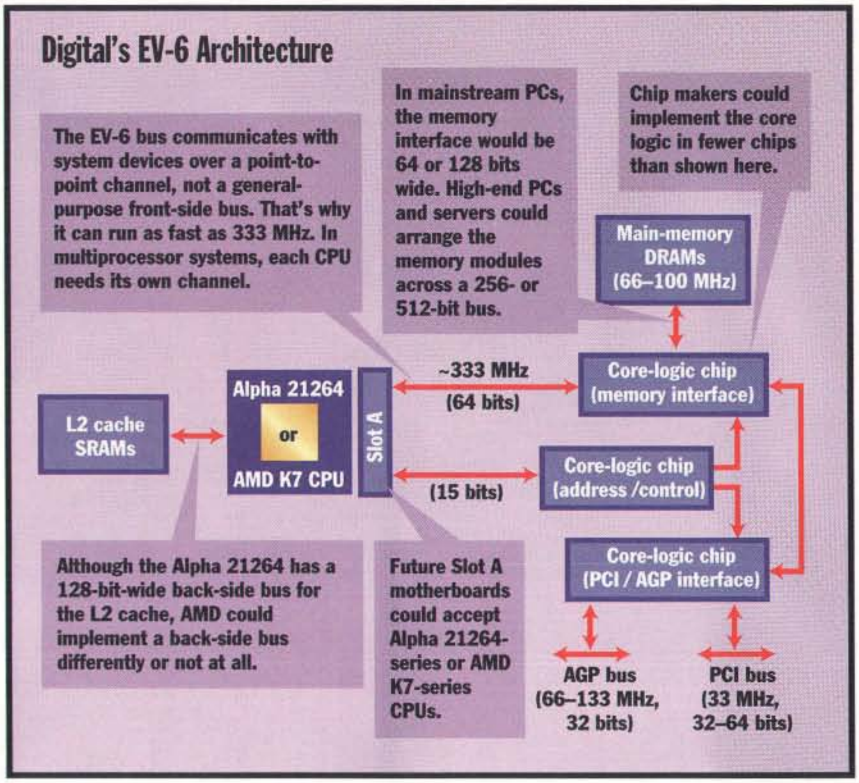
Obsolescence is a relative term, of course. If you don't install any software that was written more than a year after the machine was made, it will last virtually forever. However, few users are so disciplined. Each new software "upgrade" gradually turns their big, fast computer into a small, slow computer. Eventually, the performance becomes so intolerable that the only solution seems to be the purchase of another big, fast computer. Another vicious cycle starts.

The new philosophy calmly accepts the inevitability of this cycle—and, in fact, speeds it up. However, because each replacement machine costs less, users spend less money per year to stay current. Prices are plunging so fast that one computer-store chain is selling a custom-designed Windows PC for only $499, and it's not as stripped-down as you might think. By the end of the year, similar systems will retail for $299. (See the text box "How Low Can You Go?" on page 72.)

continued

Digital's EV-6 Architecture


Main-memory DRAMs (66–100 MHz)
~333 MHz
(64 bits)
Alpha 21264
or
AMD K7 CPU
L2 cache SRAMs
Slot A
Core-logic chip (memory interface)
Core-logic chip (address /control)
(15 bits)
Core-logic chip (PCI / AGP interface)
AGP bus (66–133 MHz, 32 bits)
PCI bus (33 MHz, 32–64 bits)

The EV-6 bus communicates with system devices over a point-to-point channel, not a general-purpose front-side bus. That's why it can run as fast as 333 MHz. In multiprocessor systems, each CPU needs its own channel.

In mainstream PCs, the memory interface would be 64 or 128 bits wide. High-end PCs and servers could arrange the memory modules across a 256- or 512-bit bus.

Chip makers could implement the core logic in fewer chips than shown here.

Although the Alpha 21264 has a 128-bit-wide back-side bus for the L2 cache, AMD could implement a back-side bus differently or not at all.

Future Slot A motherboards could accept Alpha 21264-series or AMD K7-series CPUs.

The AMD/Digital motherboard strategy unifies the CPU interface for future AMD and Alpha processors.

The Slot Thickens continued

I/O interface to go along with Slot A. The company chose Digital's 21264 interface (which is known internally as EV-6), because it offers significant advantages over Socket 7: much higher clock frequencies and better support for multiprocessing.

While Socket 7 currently runs at 66 MHz and will soon step up to 100 MHz, EV-6 can run at a blazing 333 MHz. That's over three times faster than Socket 7 or Intel's P6 bus. And although EV-6 doesn't define a separate back-side bus for an L2 cache, designers are free to add one if they wish–allowing more flexibility for different markets. For instance, Digital's high-end 21264 implements a 128-bit-wide back-side bus, twice as wide as Intel's.

How can EV-6 run at 333 MHz when even a 100-MHz motherboard is difficult to engineer? Because EV-6, strictly speaking, isn't a bus. It's a 64-bit, point-to-point I/O channel between the CPU and the system chip set. That's a major departure from today's x86 buses.

In a Socket 7 system, the CPU, L2 cache, main memory, and PCI bus all hang off the same local I/O bus. P6 systems are similar, except that the L2 cache is on a back-side bus. In both those systems, the local I/O bus must also handle the Accelerated Graphics Port (AGP), if one is present. In a multiprocessor system, additional CPUs also share the bus. This all adds up to a great deal of bus traffic.

In an EV-6 system, the CPU talks directly to the chip set over a private channel. The chip set, in turn, branches off to all the other buses: main memory, PCI, and AGP. Each of those buses runs at its own speed. Main memory could run at 66 or 100 MHz while the PCI bus runs at 33 MHz and AGP runs at 66 MHz. In a multiprocessor system, each CPU has its own private channel (clocked as high as 333 MHz) to the chip set. (See the figure "Digital's EV-6 Architecture" above.)

At 333 MHz, EV-6 has 2.6 GBps of raw bandwidth, more than three times as much as a Socket 7 or P6 bus at 100 MHz. That's an enormous advantage, because the prime factor limiting performance in modern CPUs is the time they take to access memory. A high-end system could exploit EV-6's extra bandwidth by hanging the memory on a 128-bit-wide bus on the chip set. That would double the amount of raw bandwidth to memory. Even if the memory is on a conventional 64-bit bus, EV-6's headroom should mean fewer stalls while the CPU refills its cache lines.

The downside: EV-6 chip sets are more complicated to design, and chip sets for multiprocessor systems will be expensive, because they'll need at least 64 additional pins for each CPU. AMD is working with third-party vendors such as VIA to design EV-6 chip sets.

For Digital, the big win is that future Alpha processors that have EV-6 and a Slot A cartridge will plug into the same motherboards as AMD's K7 processor. Only the BIOS needs to change. Since modern BIOSes use flash ROM, it's a quick software upgrade.

Today, Alpha systems are relatively expensive because they require special motherboards and chip sets that aren't made in large volumes. If AMD is successful, there will be a lively commodity market for Slot A motherboards. Together with lower-priced Alpha CPUs (such as an EV-6 variant of the 21164PC), this could bring Alpha system prices down to the $1500 range. The Alpha would be a mass-market product, such as the x86.

"The Alpha will benefit from the economies of scale of having a large-volume infrastructure," says Aaron Bauch, Digital's technical marketing manager.

Some observers wonder if the

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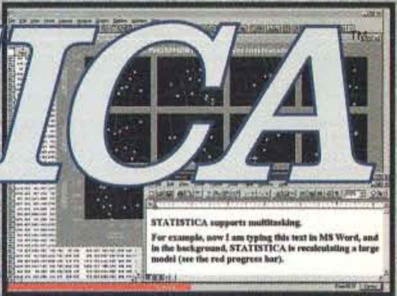

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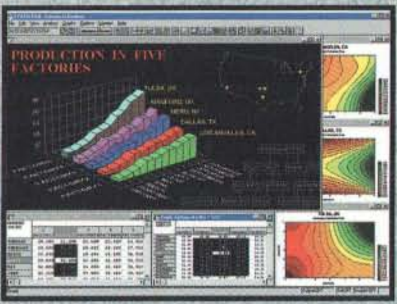

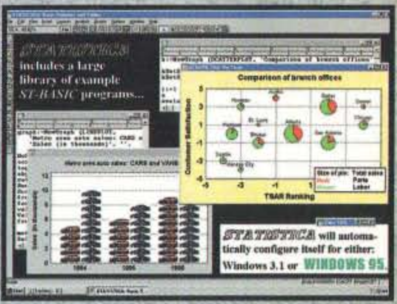

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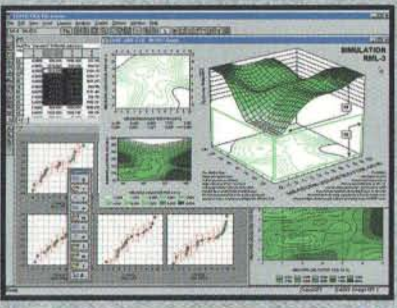

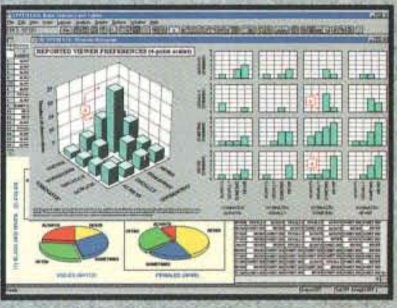

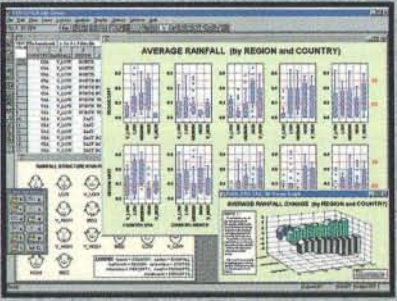

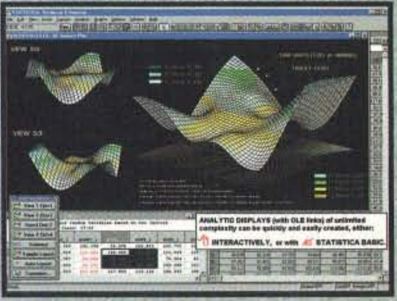

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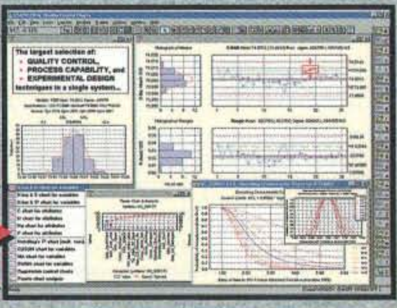

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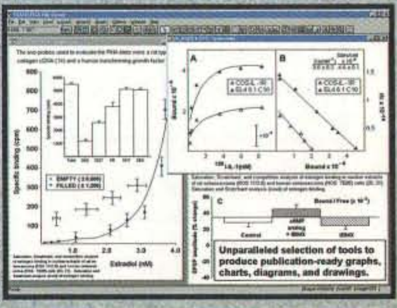

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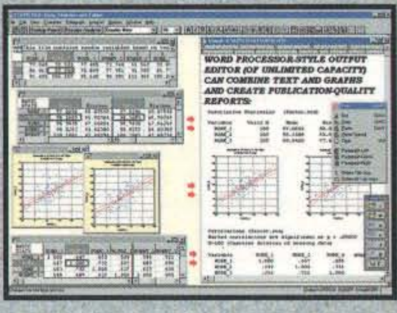

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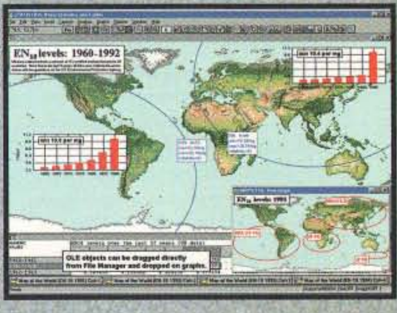

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Welcome to the disposable computer. Even if you get only one year out of the machine before handing it down to somebody or donating it to a school, the amortized purchase cost is only half as much as a $2000 system that lasts two years or a $3000 system that lasts three years. And for many common tasks, a $499 PC is fast enough.

Indeed, cheap PCs have the same attributes that made the Volkswagen Beetle popular in the 1960s: basic transportation, no complicated frills, and freedom from fashion anxiety. You never have to worry about it becoming obsolete because it's already obsolete.

Buying Smart

However, it's equally obvious that a Volks-PC isn't the ideal machine for everyone. Some users need more power to do their jobs efficiently, and anything less than the fastest available system isn't a worthwhile trade-off.

Another huge consideration—especially for businesses—is the less-visible cost of setting up a new PC. Low prices save money up front but do little to address the total cost of ownership. An often-quoted study by the Gartner Group estimated the total business cost of owning a PC with Windows 95 at $38,900 over five years. That includes administrative expenses for technical support, requisitions, purchasing, legal reviews of contracts, security, policy enforcement, and asset management. Gartner assumed a new PC every three years.

If a company replaces its PCs every year, the administrative overhead could consume the purchase savings. That's why cheap PCs don't necessarily threaten NCs, which reduce the total cost of ownership on the administrative end.

So here's the amended computer-magazine advice: Minimize your investment in transitory technology and administrative costs while carefully matching the computer to the user.

That's hardly radical advice, but it does open more options. In some cases, the best solution will be a 333-MHz scream machine loaded with all the latest trimmings. In other cases, it will be a $500 disposable PC or an NC. You might recommend a $300 WebTV to a technophobic friend, even if you wouldn't buy one yourself. The goal is to keep up with traffic, not with the Joneses.

By applying this template to the stream of new technologies, you can filter out the ones that aren't relevant. For instance, users who aren't multimedia developers, graphics designers, or game players probably don't need things such as MMX, MMX2, or AGP.

Writers and accountants probably don't need a 100-MHz system bus, a 300-MHz CPU, a FireWire interface, or the latest DRAM technology—at least, not within the life expectancy of the next system they purchase. Workers who spend all their time interacting with a centralized database might get by with an NC.

Not only can buyers save money, but they can also acquire new technology sooner than they would have otherwise. This happens when the technology churns so fast that users get new features essentially for free merely by purchasing a new system, whether they sought those features or not.

For example, Intel and other x86 chip vendors have stopped making non-MMX processors. All new PCs this year will have MMX at the same prices (or even lower prices) than last year's non-MMX PCs. Someone who bought an expensive pre-MMX system in 1996 might still be amortizing the high cost over a longer period, while the bottom-feeders are snapping up sub-$1000 boxes with MMX.

Technology churn will accelerate the trend toward the cheaper PCs. Why should users lock themselves into costly systems that will not have next year's features?

continued

The Slot Thickens continued

industry will support two or more different CPU interfaces that require different motherboards and core-logic chips. A few years ago, that would have been a major concern. But the industry has grown so large that companies can profitably support multiple standards.

"It's no big deal to design a custom motherboard for different CPUs," says Don Clegg, vice president of marketing for Tyan Computer, a major motherboard manufacturer. "But we'd like to see the motherboard form factors remain industry-standard: AT, ATX, NLX. If the board doesn't fit a standard chassis, it will become more like the notebook market."

There are other considerations that might determine how many companies support AMD's slot. Tyan won't say if it plans to build Slot A motherboards but notes that it enjoys good relations with Intel and would like to keep it that way.

On the other hand, Intel's encroachment into the motherboard and core-logic business is squeezing some companies out of the market. Therefore, they may have little choice but to support an alternative.

AMD's plan could have a greater chance of succeeding if other x86 vendors also adopt EV-6. Digital says it's willing to license the technology to anyone. However, Cyrix told BYTE it will not use EV-6. Instead, Cyrix hints it may clone Intel's P6 interface, despite the scary patents. Cyrix was recently acquired by National Semiconductor, and National has a patent cross-licensing agreement with Intel. Cyrix thinks that agreement might cover the P6 interface. If Intel sees things differently, Cyrix could fight it out in court.

"I don't intend to lose," says Steve Tobak, vice president of corporate marketing for Cyrix. "We've never lost in court to Intel before."

The third independent vendor of x86 processors, Centaur Technology, isn't talking about its plans beyond Socket 7. It's possible that Centaur could stick with the socket longer than others, because Centaur aims for the low-end market, where Socket 7 is not really a handicap.

Can AMD and Digital succeed in establishing a viable alternative to Intel's P6 standard? There's a good chance they could pull it off. AMD captured about 10 percent of the x86 market in 1997. That's down from 30 percent in 1992, when AMD's 386 competed strongly with Intel. But with the market expanding beyond 100 million units a year, even 10 percent could be enough to sustain Slot A.

AMD has grander ambitions, though. Jerry Sanders says AMD must recapture about 30 percent market share to pay for the expensive R&D and chip foundries required to compete with Intel in the future.

That will be much more difficult to achieve, unless the swing to lower-priced PCs cuts deeply into Intel's high-margin business. Intel's profit margins are soaring above 60 percent–higher than Apple's in the 1980s. If sub-$1000 systems continue to grow in popularity, Intel will have to sacrifice either profit margins or market share.

It's a balance of technology and business. Intel may choose to preserve its current business model, keep its shareholders happy, and allow AMD to recapture the market share it enjoyed in the heyday of the 386.

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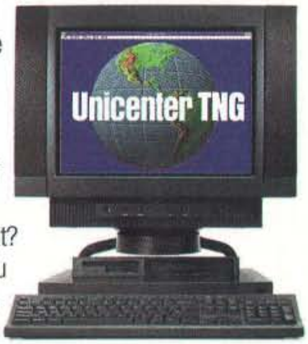

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How Low Can You Go?

Not long ago, skeptics ridiculed the idea that a network computer (NC) could cost less than $500. Today, you can buy a real Windows PC for under $500 and consumer NCs for under $300.

The $499 Windows PC isn't a refurbished 486 with stripped-down features. The PowerSpec 1660 has a 166-MHz Cyrix MediaGX processor, 16 MB of extended data out (EDO) RAM, a 1-GB hard drive, a 12× CD-ROM drive, a 1.44-MB floppy drive, a 33.6-Kbps fax modem, and a pair of stereo speakers. It also has two serial ports, two PS/2 ports, a parallel port, a joystick port, and a shared PCI/ISA slot. It comes with Windows 95, Microsoft Works, Microsoft Money HomeBanking, Microsoft Entertainment Pack, and a one-year on-site warranty for parts and labor. All you need to add is a monitor and a printer.

Although the PowerSpec 1660 clearly isn't a power-user system, it's a reasonable machine at a remarkable price. It's sold by Micro Center, a chain of computer stores that covers eight states. Elitegroup Computer Systems, a Taiwanese company, manufactures the PowerSpec 1660 for Micro Center. Elitegroup makes the motherboards in Taiwan and assembles the boxes in Fremont, California.

Elitegroup says it can deliver a $299 Windows PC by the end of this year. "It might be sooner, but this is a safe prediction," says Ann Vo, a public-relations specialist at the company's Fremont office.

Compaq, one of the top three PC vendors, helped pioneer this trend with the Presario 2100 in February 1997. Based on a 133-MHz MediaGX, the 2100 came in a sleek black desktop case and sold for $999. Soon afterward, Compaq introduced the Presario 2200, which has a faster 180-MHz MediaGX and a more aggressive price of $799.

To put these bargain-basement systems into perspective, compare them with two of the most popular low-end computers of all time: the Commodore VIC-20 and the Commodore 64. The VIC-20 cost $299 at its introduction in 1981; the C-64 cost $595 when it first appeared in 1982. Adjusted for inflation, the $499 PowerSpec 1660 would cost about $271 in 1981 dollars and about $295 in 1982 dollars.

The difference in horsepower, of course, is immense. The VIC-20 had a 1-MHz 6502 processor and 5 KB of RAM; the C-64 had a 1-MHz 6510 chip and 64 KB of RAM. Neither Commodore machine came with any kind of mass-storage device at their base price, while today's low-end systems come with three (hard drive, floppy drive, and CD-ROM drive).

On the other hand, the Commodore computers had several features that most of today's PCs still aspire to: instant-on power; a plug-and-play serial bus for external peripherals; an easy-access, external expansion slot; integrated sound chips; integrated graphics; built-in joystick ports; an uncorruptible OS in ROM; a high-level programming language interpreter that was integrated with the OS (BASIC, not Java); no interrupt conflicts; no software conflicts; and no need to ever install software. With any luck, Windows PCs will catch up to most of those features by the next century.

Cyrix's MediaGX processor powers sub-$500 PCs.

Meanwhile, technophobic consumers might consider a home NC. For under $300, they can buy a WebTV Plus Receiver from Sony or Philips that plugs into their TV and lets them browse the Web and exchange e-mail. This box has a built-in Rockwell K56flex modem, a 1.1-GB hard drive for caching Web pages, and the ability to download Web pages and software upgrades at 1 Mbps by decoding data in hidden TV scan lines. You can even hook up an ink-jet printer.

What's important is that these low prices revive a market that PC clones haven't addressed for years. An amazing number of today's computer professionals started on a cheap home computer when they were youngsters in the 1970s and 1980s. The new low-priced PCs will seed another generation of technicians for the future.

Paradoxically, this motivates the industry to churn the technology even faster. Vendors make less profit on low-end systems; new whizbang features justify higher prices. But when the technology churns so fast that users can't amortize a high-end system before it becomes obsolete, they tend to buy less expensive systems. It's a feedback loop!

So if you don't like the idea of planned obsolescence, don't get mad—get even. Buy a new PC every year.

Tomorrow's Tributaries

"There's obviously a battle shaping up over what the mainstream PC is going to be," says Don Clegg, vice president of marketing at Tyan Computer, a major motherboard manufacturer.

Time was, you could easily recognize a mainstream PC on sight: It was a big, ugly beige thing that took 3 minutes to turn on and sounded like a vacuum cleaner. Soon, that concept will be obsolete. Already, some PC vendors are trying to change that image to further the illusion that PCs are user-friendly consumer appliances. You can buy PCs with charcoal-gray cases, built-in stereo speakers, and "instant-on" power buttons (which, to be more accurate, are really "never-off").

More significantly, leading vendors such as Compaq and Gateway 2000 are experimenting with wildly different types of PCs that are hybrid TV-PCs, DVD-PCs, or home-theater PCs.

"Culturally, the industry is very limited in what it thinks is a PC," says Paul Pascarelli, Cyrix marketing manager for the MediaGX chip. "MediaGX is an architecture for devices that need x86 intelligence but don't necessarily have to resemble ordinary PCs or run the same kind of software as traditional PCs."

It's not just an issue for the home market. In the business world, the need for more alternatives has spurred the evolution of NCs, NetPCs, Windows CE palmtops, the PalmPilot, and a wider variety of notebook computers. In nerd-speak, segmentation lets users match the computing device to the task with a greater degree of granularity.

Don't be fooled into thinking that everything is converging on a single platform: x86 and Windows. Superficially, it looks that way, especially with the decline of alternative platforms such as the Mac. However, no platform can be all things to all people. The apparent winner of the platform war is unmistakably splintering into subplatforms.

In terms of system architecture, for instance, a MediaGX PC requires a specially designed motherboard that won't work with any other CPU or standard core-logic chips. It doesn't need a sound card, a graphics card, or an L2 cache. It runs Windows and works with standard peripherals, but

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BYTE Readers Put PCs Out to Pasture Faster

Rapid obsolescence is forcing BYTE readers to replace their home and office PCs more often. Readers are also sharply divided on the question of proprietary CPU interfaces and are more likely to buy or recommend a non-Intel processor for home use than for office use. Those are just a few of the conclusions we reached from a telephone survey that gauges how 115 BYTE readers perceive current changes in the PC market. BYTE's research department conducted the survey in November by randomly calling readers from the magazine's subscription list.

We wanted to determine how readers are coping with rapid obsolescence. Not surprisingly, 84 percent told us they're replacing their office PCs more often, and 66 percent said they're replacing their home computers more often. The largest number of readers–43 percent–say they keep their office PCs for three to four years. About 25 percent get only two to three years out of a PC at the office, and 13 percent get less than two years. All together, 81 percent of our readers' office PCs are obsolete within four years.

At home, readers tend to keep their PCs a bit longer before considering them obsolete. Again, the largest number–39 percent–say they keep a home PC for three to four years. About 10 percent get two to three years out of a machine; 16 percent get less than two years. All together, 64 percent of their home PCs are obsolete within four years.

About 40 percent of the readers said they upgrade a machine as much as possible before replacing it, while about 58 percent said they buy a whole new computer.

We also asked what readers think about PC motherboards that have nonproprietary CPU interfaces–in other words, motherboards that can accept a CPU chip from any vendor, as Socket 7 motherboards can. The answers were remarkably distributed. For office PCs, 34 percent answered that open interfaces are "very important," 33 percent answered "somewhat important," and 31 percent answered "not at all important." For home PCs, 35 percent answered "very important," 32 percent answered "somewhat important," and 32 percent answered "not at all important." The results show that two-thirds of the readers think open CPU interfaces are somewhat important, but it's not a black-or-white issue.

Another question measured how many readers would buy or recommend a PC with a non-Intel x86-compatible processor. For office PCs, 17 percent said they would be "very likely" to buy or recommend such a system. Another 43 percent answered "somewhat likely," while a significant 41 percent said "not at all likely." For home PCs, readers were a little more open to the idea: 27 percent answered "very likely," 33 percent said "somewhat likely," and 38 percent answered "not at all likely." Interestingly, the three major vendors of non-Intel x86 chips–AMD, Cyrix, and Centaur–together command only about 10 percent of the market.

We asked readers to assess the importance of 14 new or emerging technologies. Because these technologies are major factors in the accelerating obsolescence of PCs, the answers give some indication how readers will determine when their systems become obsolete. We asked readers to judge the technologies on a scale of 1 to 5 ("not very important" to "very important").

The results suggest that readers are more concerned about system performance than local storage capacity. Convenience, represented by USB, also did well.

How BYTE Readers Rank New Technologies

Technology	Rank	Score (1–5)
100-MHz system bus	1	3.98
100-Mbps Ethernet	2	3.92
CPUs > 300 MHz	3	3.57
USB (universal serial bus)	4	3.34
AGP (Accelerated Graphics Port)	5	3.32
IA-64/Merced processor	6	3.28
SDRAM replacing EDO RAM	7	3.24
Device Bay interface	8	3.09
100-MB internal Zip drives	9	3.02
DVD-ROM replacing CD-ROM	10	2.97
120-MB floppy drives	11	2.94
Intel's MMX2 extensions	12	2.93
PCs without ISA slots	13	2.38
AMD/Cyrix/Centaur new x86 instructions	14	2.34

internally it's an architecture unto itself. By next year, it won't even have an Intel-standard x86 instruction set.

Then there are completely different architectures, like Microsoft's WebTV. For the first time, Microsoft has direct control (as opposed to de facto control) over a system architecture. What will Microsoft do with it? Future WebTVs could always remain WebTVs, or they could grow upward to become more like regular PCs—an evolution that's already apparent in the latest WebTV Plus models, which come with hard drives and printer ports.

The same opportunity is open for video game consoles such as the Sony PlayStation and Nintendo 64. These devices are more powerful than many PCs and are made by companies that have vast experience in consumer marketing.

In the past, rogue architectures found it difficult to survive, even when they offered breakthrough features. (Remember the Amiga?) However, as the computer market continues to broaden and grow into the hundreds of millions of units, there will be further room for alternatives—as long as they don't challenge the status quo too radically. ■

WHERE TO FIND

Advanced Micro Devices
Sunnyvale, CA
800-538-8450
408-732-2400
http://www.amd.com

Cyrix Corp.
Richardson, TX
800-462-9749
972-968-8388
http://www.cyrix.com

Elitegroup Computer Systems
Fremont, CA
510-226-7333
http://www.ecs.com.tw

Intel Corp.
Santa Clara, CA
408-765-8080
http://www.intel.com

Tom R. Halfhill is a BYTE senior editor in San Mateo, California. You can contact him at **tom.halfhill@byte.com.**

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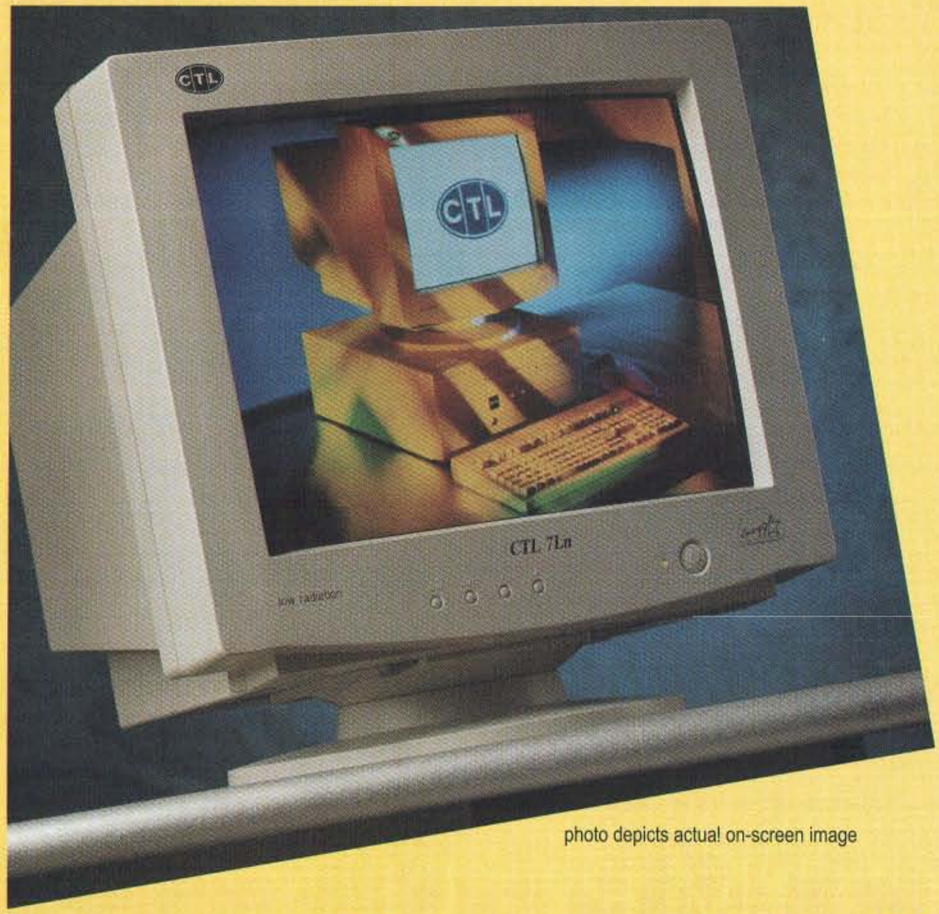

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JACKPOT AT COMDEX

You and nearly a quarter-million of your closest friends converge once a year on Las Vegas to witness the spectacle that is Comdex.

Each year at Comdex, new innovations share the floor with remakes of old products. BYTE editors separate the wheat from the chaff and tell you what really matters in several categories.

We were impressed with the maturity of some technologies that we've been following for a while. Chief among those were alternate input systems, which dominated our productivity applications category with voice and handwriting-recognition systems. The computers on the show floor ranged from very-low-end $500 PCs to near-$10,000 multimedia entertainment centers. And IBM demonstrated a new car. (In each category, the winner is the first item, followed by runners-up.)

Best of Show

Hewlett-Packard LaserJet 4000

It's not anything you can see that makes the top-of-the-line HP LaserJet 4000 our Best of Show winner. Instead, implemented inside the LaserJet 4000 is Hewlett-Packard's JetSend protocol. This is a TCP/IP-based protocol that enables network devices to talk to each other without using a computer as an intermediary. If you want to send a document that you just scanned on a JetSend-enabled scanner direct to a JetSend-enabled printer, all you have to do is select the printer from the scanner's control panel and off it goes.

Hewlett-Packard
Palo Alto, CA 800-527-3753
http://www.solutionjet.hp.com/LJ4000/

Systems

TriStar StarStation SXE

If you're looking for the ultimate entry into the world of great 3-D graphics, look no further than Tri-Star's StarStation SXE. This $2600 system is built on the 533-MHz Alpha 21164PC and sports a 16-MB Elsa Gloria graphics card and a 6-GB EIDE drive.

Tri-Star
Phoenix, AZ 800-800-7668
http://www.tristar.com

IBM IntelliStation M Pro

This Windows NT workstation features one or two 300-MHz Pentium II processors, is Accelerated Graphics Port–ready (AGP), and has a price starting at $3500.

IBM PC
Research Triangle Park, NC
800-426-7255
http://www.pc.ibm.com/intellistation

Gateway Destination DMT

Gateway improves on a good thing with its Destination DMT. It offers a marriage of PC and home theater in one system. The new version offers a 36-inch display, a DVD-ROM (digital versatile disc) drive with an MPEG-2 decoder, and a six-piece surround-sound stereo system. Prices range from $3100, for an entry-level system with a 166-MHz processor and 32 MB of RAM, to $4999, for a unit powered by a 300-MHz Pentium II.

Gateway 2000
North Sioux City, SD
800-846-2000
http://www.gateway.com

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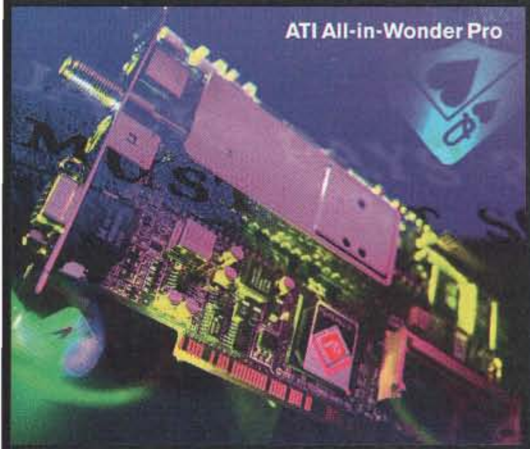


Multimedia Hardware/Software

ATI All-in-Wonder Pro

The addition of ATI's 3-D Rage Pro chip increases the All-in-Wonder Pro's 3-D graphics performance by a factor of three over its predecessor, setting up 1.2 million triangles per second. This PCI card also has competitive 2-D graphics acceleration. But its multimedia capabilities are what set the All-in-Wonder Pro apart. A TV tuner with NTSC output, video zooming and 10-second instant replay, still- and full-motion video capturing to disk, and close-captioned text searching and recording top this list. The suggested retail price is $325, with street prices under $300.

ATI Technologies
Thornhill, Ontario, Canada 905-882-2600
http://www.atitech.com/

Creative Labs Sound Blaster AWE 64D

Here's a PCI sound card with a unique twist: a special motherboard connector that improves backward compatibility with programs that expect to find ISA sound cards. The Sound Blaster AWE 64D's motherboard component tricks the software into thinking the PC has an ISA sound card installed, so DOS games and other older programs should run without balking. A large number of motherboard manufacturers support the special connector— including Intel, the leading motherboard maker, A-Open, Asus, Chaintech, FIC, and Gigabyte.

Creative Labs
Creative Resource, Singapore +65 895 4000
http://www.soundblaster.com/

Pinnacle Systems' miroVideo DV300

The miroVideo DV300 is a hardware/software digital-video editing package that has an amazing range of professional-level features for $799. The DV300 lets PCs communicate with digital-video camcorders through an ISO-1394 FireWire interface to enable frame-accurate control of the camcorder. It automatically retrieves and replaces dropped frames, so the DV300 can create error-free digital-video captures. An on-board SCSI controller frees up the PCI bus, delivering better disk performance. It has a plug-in for Adobe Premiere that renders only the newly added special effects and transitions in reedited scenes.

Pinnacle Systems
Mountain View, CA
650-526-1600
http://www.pinnaclesys.com/

Storage

Sony HiFD

It's easy to ignore the good old 3½-inch floppy drive. Fujifilm, along with Sony, the inventor of the 3½-inch floppy drive, has released the HiFD. It offers 200-MB capacity in drives that can read 1.44-MB disks.

Sony
San Jose, CA 800-352-7669
http://www.sony.com/storagebysony

IBM Deskstar 16GP

IBM has had its share of patents in hard drive technology. One of the latest is giant magneto-resistive (GMR) heads, which are two to three times more sensitive than existing heads and thus able to handle higher medium densities. This $875, 5400-rpm drive is the first in a line that IBM says could lead to affordable desktop drives of 32 GB or more by 1999.

IBM Storage Systems Division
San Jose, CA 800-426-7777
http://www.ibm.com/storage

Iomega clik

Iomega says it wondered how small a Zip disk could be. The answer is 2 inches wide—small enough to fit in most hand-held PCs (HPCs) and digital cameras. The clik disk holds 40 MB and sells for $10. Add a cell-phone-size external drive (for about $100) and you have the most portable storage device yet.

Iomega
Roy, UT 800-697-8833
http://www.iomega.com

TriStar StarStation SXE

Server Systems

Axil Northbridge NX803

The eight-way multiprocessing battles have been joined, and Axil has a serious force. Axil's unique motherboard design plans for future Intel processor upgrades, allowing customers a longer product life cycle. Its rack design includes three power supplies with hot-swap capability and a hot-swap fan tray.

Axil Computer, Inc.
Concord, MA 978-371-8100
http://www.axil.com

Land-5 Icebox

Land-5's I_2O-capable Icebox server sports unique disk and tape RAID components that do not require drivers for any server OS. The RAID 3 tape-drive array is capable of 20-MBps data transfer.

Land-5
San Diego, CA 619-566-2514
http://www.land-5.com

Productivity Applications

ParaGraph Calligrapher 5.0

HPC keyboards are too small for most of us. Enter Calligrapher 5.0, the product of years of research into handwriting recognition. Designed to interpret cursive handwriting—even the particularly inscrutable handwriting of BYTE

Axil Northbridge NX803

senior contributing editor Jerry Pournelle—Calligrapher is one package no HPC should be without.

ParaGraph
Mountain View, CA
650-933-3000
http://www.paragraph.com

Lernout and Hauspie VoiceXpress

VoiceXpress from Lernout and Hauspie is continuous speech-recognition software with up to a 65,000-word vocabulary. Big deal, you think? Not so fast. VoiceXpress's editing capabilities set it apart from the pack. After transcribing what you say, it's a snap to format your text with simple voice commands, changing properties such as fonts, point size, and alignment.

Lernout and Hauspie
Waltham, MA 781-238-0960
http://www.lhs.com

Lexicus Japanese Handwriting Recognition

The Japanese Handwriting Recognition software, from Motorola's Lexicus division, works with several Japanese character sets, including kanji and katakana, and recognizes roman characters that frequently appear in Japanese writing. The software comes bundled with a graphics tablet, and it lets you insert the characters directly into applications such as Microsoft Word and Eudora Pro.

Motorola (Lexicus division)
Palo Alto, CA
650-494-0800
http://www.mot.com/lexicus

Portables
Sony PCG-505

Some vendors had mini-notebooks, and others had ultrathin systems, but only Sony, using a magnesium alloy and a 10.4-inch thin-film transistor (TFT) SVGA LCD, created a system as small and powerful as the amazing PCG-505. Hold it in your hand and feel its 0.95-inch-thick, 2.97-pound case. Boot it, and play with its 133-MHz MMX Pentium and usable keyboard. This is the system most mini-notebooks aspire to be.

Sony Electronics
San Jose, CA 800-325-7669
http://www.sony.com

IBM ThinkPad 560X

IBM's ThinkPad 560X puts a 233-MHz Pentium with MMX in a highly portable, 4.1-pound, 1.2-inch-thick form factor with a 12.1-inch TFT SVGA screen for $4299. When locked into its docking station, it has all the functionality of its heavier, bulkier, high-end competitors.

IBM
Armonk, NY 914-288-3589
http://www.ibm.com

Sharp Mobilon

You think all Windows CE 2.0 computers are the same? Think again. The Sharp Mobilon uses a camera add-on to double as a 640- by 480-pixel screen. It comes with either a color or monochrome LCD and starts at $599.

Sharp Electronics
Mahwah, NJ 800-237-4277
http://www.sharp-usa.com

Peripherals
Hewlett-Packard LaserJet 4000

BYTE's Best of Show winner, the 1200-dpi, 17-ppm HP LaserJet 4000 comes with two 250-sheet paper trays and up to 8 MB of memory. What's most important for us, it uses the revolutionary JetSend protocol, which allows devices to communicate over TCP/IP.

Hewlett-Packard
Palo Alto, CA 800-527-3753
http://www.solutionjet.hp.com/LJ4000/

Ositech Jack of Spades

This combination 10-/100-Mbps Ethernet card/56-Kbps PC Card modem lets you make connections not only through analog phone lines, but through digital lines, too. Ositech's Digital Phone Interface (DPI) technology enables you to connect the modem between the handset and the base of the phone on virtually any phone.

Ositech Communications, Inc.
Guelph, Ontario, Canada 888-674-8324
http://www.ositech.com

Best Technology
Cyrix Media Center/MediaGX

With its Media Center technology demonstration, Cyrix added a new wrinkle to the network computer versus personal computer debate by developing an affordable PC-compatible information appliance. The Cyrix Media Center is built around Cyrix's integrated 200-MHz MediaGX chip. It adds a 56-Kbps modem, universal serial bus (USB), IEEE-1394 FireWire, stereo speakers, accelerated 3-D graphics, video capture, and a TV and FM radio tuner. It supports legacy devices like a floppy drive, keyboard, mouse, and serial and parallel ports. This will allow full-featured PCs for under $1000.

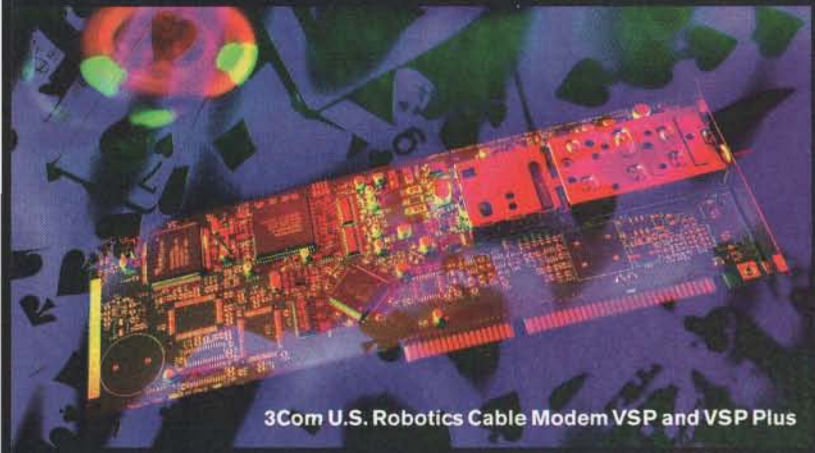
Cyrix Corp.
Richardson, TX 972-968-8388
http://www.cyrix.com

Sony 400PS

The 400PS monitor sports digital dynamic convergence, enhanced elliptical correction, and active signal correction. You get a high-quality picture with superb clarity across the entire screen.

Sony Electronics
San Jose, CA 800-426-7255 http://www.sony.com

Sony PCG-505



3Com U.S. Robotics Cable Modem VSP and VSP Plus

Network Infrastructure

3Com U.S. Robotics Cable Modem VSP and VSP Plus

Cable modems promise some of the biggest pipes for most of us. But infighting over standards is holding products out of the reach of most of us. No longer. First to market with an MCNS-standard cable modem, 3Com uses either your own modem or an included 33.6-Kbps modem to provide upstream communication, while letting cable companies deliver up to 27 Mbps downstream. Pricing is $199 for cable only or $250 with the modem.

3Com Corp.
Santa Clara, CA 408-764-5000
http://www.3com.com

Bay Networks' Instant Internet (100)

Instant Internet (100) offers the lowest-cost proxy server and firewall yet for small IPX and IP networks. For $750, this modem-size box provides easy installation and configuration for small workgroups to connect to the Internet quickly at 56-Kbps analog modem or 128-Kbps ISDN speeds, using a low-cost ISA-card design.

Bay Networks
Santa Clara, CA 408-988-2400
http://www.baynetworks.com

The Damnedest Thing We Ever Saw

It runs on gas and Java. It has power steering and multiple processors. Fuel injection and five LCDs. It's the IBM network vehicle. A joint project of Sun, Delco, and IBM, the network vehicle is a remade Chevy Blazer. The user interface is written in Java and appears on several LCDs around the vehicle. Passengers can check e-mail, browse the Web, or download a movie, all courtesy of a DirecPC satellite connection that comes in through the vehicle's phased-array antenna. Voice recognition gives drivers control over a heads-up display and lets them ask for directions.

IBM North America
White Plains, NY
520-574-4600
http://www.ibm.com/TradeShows/comdex/Fall97/1117s.htm

AT&T WorldNet Virtual Private Network Service

Virtual private networks have traditionally been obscurely priced, and service guarantees have only begun to emerge. AT&T's contribution is clearly priced, including flat-rate dial-up service starting at $34.95 for 20 hours or $103 per month for a 16-Kbps frame-relay service. Customers with outages as short as 10 minutes can receive refunds.

AT&T
Bridgewater, NJ 973-331-4000
http://www.attnet.net/worldnet

Network Applications

Citrix piCAsso

These days, it seems everybody's doing the thin-client thing (even if they aren't sure what thin client means). Citrix has been doing it since long before it was the flavor of the week. You've probably been hearing quite a lot about Microsoft's Hydra—a technology letting thin clients access applications on Windows NT servers. Hydra is built on the core technologies inside Citrix's WinFrame, and pICAsso is the code name for an enhancement to Citrix's ICA technology that enables cross-platform connectivity (i.e., it runs on Mac, OS/2, and Unix systems) and audio to run over ICA.

Citrix
Fort Lauderdale, FL
954-267-3000
http://www.citrix.com

Novell Storage Services

Novell Storage Services (NSS) represents the future file system for NetWare. Its main feature, aside from its high capacities (Novell has already created a 2-TB file and a 3-TB volume), is its reliability. If a server goes down, NSS can rebuild a volume quickly—in a demonstration for BYTE, it was able to rebuild a 100-GB file system in a little over a minute.

Novell
Orem, UT 801-861-7000
http://www.novell.com

Inferno 2.0

Inferno is a small-footprint, extremely modular, highly portable operating system for embedded applications. Version 2.0 enhances the previous version with full support for Sun's PersonalJava, a subset of Java designed for network-connectable products used in homes, while traveling, or in the office. It also includes a suite of general-purpose productivity apps for small devices.

Lucent
Murray Hill, NJ
317-322-6848
http://www.lucent.com

Development Tools

NuMega Technologies TrueTime VB Edition

Is your code feeling sluggish lately? Debugging-tool vendor NuMega Technologies attacks the problem with TrueTime Visual Basic Edition. This code-optimization tool puts ActiveX components in its sights. It spots the sluggards in your code—even components without source code.

NuMega Technologies
Nashua, NH 603-578-8400
http://www.numega.com

GEO Publishing Emblaze Web Chargers

On the Web, the most notorious bandwidth hogs are those images that make sites so appealing. Rather than scaling back the images, GEO Publishing's Emblaze Web Chargers lets Webmasters drastically reduce the size of graphics files by selectively compressing parts of images. A little snip here, a little trim there, and you can have a beautiful—and fast—site.

GEO Publishing
Woodland Hills, CA
800-576-7751
http://www.emblaze.com

NEC Systems Laboratory's Auraline Java Multimedia Creation Kit

Java programmers who struggle with JavaScript to animate their Web sites might appreciate NEC Systems Laboratory's Auraline Java Multimedia Creation Kit. This $20 toolkit packages popular Web-site multimedia tricks such as ticker tapes and rollover effects in Java applets that you call from a time-line interface. It can save hours of tedious coding.

NEC Systems Laboratory
San Jose, CA 408-433-1358
http://www.auraline.com

Making Components Portable with JavaBeans

JavaBeans, Java's component architecture, is far more than just a collection of components for the client. ***By David S. Renshaw***

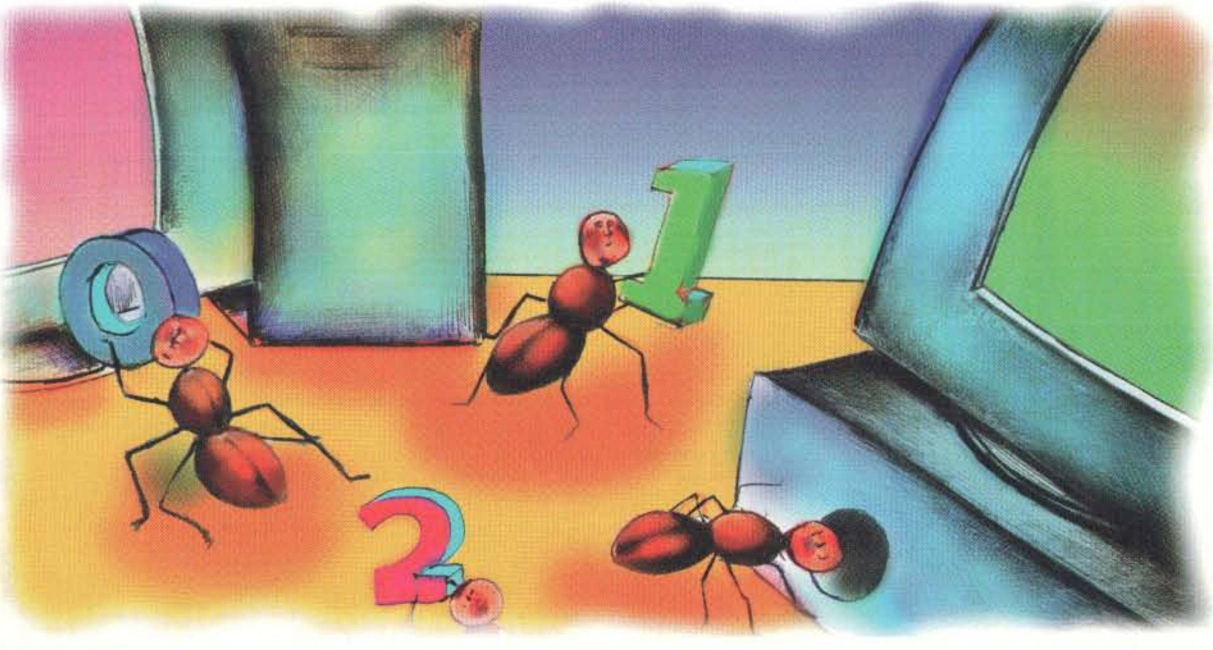
More OSes. More users. More applications to develop. Less time. When you're developing applications for the kinds of heterogeneous environments that make up today's information-technology (IT) infrastructure, you need to solve cross-platform development problems in a heartbeat. And JavaBeans offer a solution.

JavaBeans combine the benefits of Java (e.g., cross-platform development and execution) with the benefits of components (e.g., code reuse). A JavaBean is a Java component that can be developed on one OS and hardware platform and reused everywhere. As with Java, many people peg Beans as a client-side solution, but this simply isn't the case. Beans hold the key to integrated, *n*-tiered solutions using the diverse array of platforms that make up today's critical business systems. Beans take the benefits of software components beyond the bounds of the presentation tier and enable them throughout a heterogeneous *n*-tiered enterprise.

If you thought Beans were merely a client-side toy, you may be surprised. This article looks at just what Beans are, what it's like to develop with them, what they can do now—and what they'll be able to do in the future, as well as what role they can play in the enterprise.

Beans and ActiveX

For many of us, the most familiar component model is Microsoft's Windows-based ActiveX. By far, ActiveX dominates today's component market. ActiveX components and JavaBeans are similar on the surface, but the real, function-



ILLUSTRATIONS: PAT LEIDL © 1998

al differences between them are numerous and deep. I'll address these differences first.

A JavaBean is a software component written entirely in Java, or at least compiled from some source language to Java bytecode. A JavaBean might encapsulate the function of some part of the user interface (using Java's Abstract Window Toolkit [AWT], for example), or it might work as something without a visible representation (e.g., a server Bean). A component constructed according to the JavaBean recipe will execute on any system that provides a Java execution environment. In other words, JavaBeans are platform independent.

This is one of the major differences between ActiveX components and JavaBeans: ActiveX is a platform-specific model. An ActiveX component is written and compiled for a particular OS and hardware and uses OS calls. It runs only on the platform that it's built for. The only platform ActiveX components initially could be built for was Windows, but Microsoft recently moved the ActiveX technologies to other platforms, such as the Macintosh and some Unix variants. However, ActiveX is still far from having support on all the platforms that are currently in widespread use.

Compared to ActiveX components, JavaBeans are lightweight. The encapsulation of function into a Java component does not cause code bloat, the executable objects are quite small, and the developer is not required to implement countless methods. Another significant difference between ActiveX components and JavaBeans is in their respective security implications (see the text box "Safe Beans" below).

There are additional areas where the advantages of the JavaBeans model are evident. One of these areas is DLLs. ActiveX components can be packaged in several different forms, but they are usually delivered as DLLs. As such, these components need to be installed, if only temporarily, into a user's system so that they can be executed.

Registering a control in a system has effects on other applications executing on the system. For instance, Windows allows only one copy of a particular DLL to be loaded. If your browser downloads an ActiveX component that loads a DLL, that DLL is shared by all the processes that are running. If you start another application that uses the same DLL, it will be linked to the DLL already in memory. If the two applications need different versions of the DLL, problems can result. However, with JavaBeans executing in separable sandboxes (for more information about the Java sandbox, see the text box "Safe Beans" below), this problem does not happen.

Cooking Beans

So Beans are cross-platform, small, and safe. But how do you create them? The answer: pretty easily. Essentially, a Bean is a Java class that abides by a few relatively simple rules and design patterns. The infrastructure for executing Beans is provided by version 1.1 of Java. What are the basic parts of a Bean that we are required to provide?

- Beans must have null constructors.
- Beans communicate with each other by raising and listening for events, so they must define event interactions.
- Beans must have persistence mechanisms.
- Beans must be easy and efficient to distribute.
- Beans must provide mechanisms that enable a visual development tool to work out what methods and events the Beans have.

Apart from these five features, there is nothing special about a Bean; you could just as easily build a Java applet or application. In fact, Bean development can be a little simpler because you don't need to worry about starting, stopping, or initializing. Here's a closer look at each of the above five characteristics.

Bean creation. You create a JavaBean by using either the `new` instruction or the static `instantiate` method on the `java.Beans.Beans` class:

```
MyBean Bean = new MyBean();
```

or

```
ClassLoader cl = this.
  getClass().getClassLoader();
MyBean Bean =
  (MyBean)Beans.instantiate
    (cl,"xx.yy.MyBean");
```

SAFE BEANS

ActiveX has evolved from the relatively isolated environment of the desktop toward the networked computing model that includes the Internet. In a desktop computer system environment, users (or their support infrastructure) control what is installed on the systems. If it comes out of a shrink-wrapped box, then it's probably safe and trustworthy. But this is not always the model for today's computer networks.

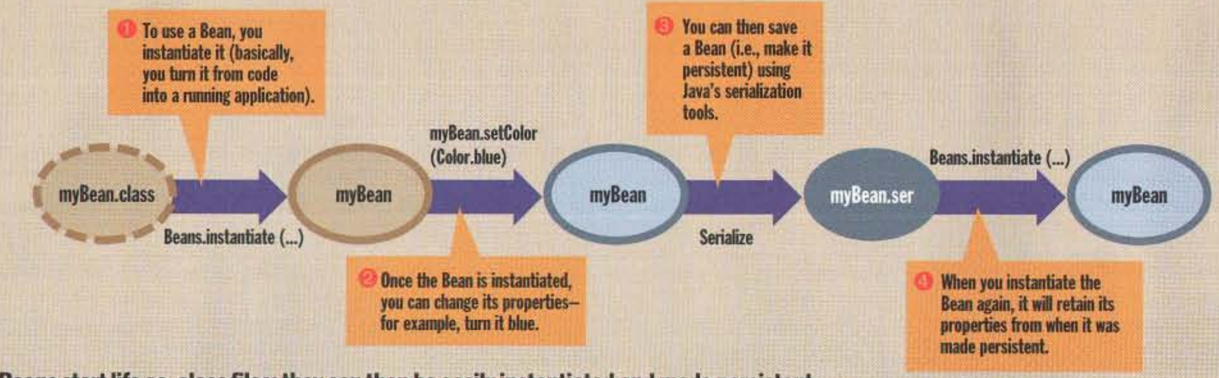
With the advent of the Internet and corporate intranets, more of the software on users' systems is downloaded on demand from a corporate network. The code is often embedded within the HTML content and arrives at the user's system unbidden. This software is almost never installed in a controlled manner and is usually intended to reside on the system only as long as the user accesses the containing page.

This model originated with Java, and, not surprisingly, the Java security model is designed for it. All Java code executes in a controlled environment called the Java sandbox. This sandbox fully controls what parts of a system are accessible. This is possible because the Java application can use only those facilities of class libraries that are loaded by a class loader that cooperates with the security mechanisms.

ActiveX has no equivalent to the sandbox. ActiveX components are compiled to hardware-specific instructions and use OS calls directly. An ActiveX component can do anything it likes to the user's system once it has been downloaded.

Microsoft has papered over this fundamental flaw by using certificates. The idea of signing a piece of code so that a user can ensure it arrives undamaged and comes from a trustworthy source simply means that the user knows whom to blame when his or her system crashes; it does not stop it from crashing.

Life of a Bean



① To use a Bean, you instantiate it (basically, you turn it from code into a running application).

② Once the Bean is instantiated, you can change its properties—for example, turn it blue.

③ You can then save a Bean (i.e., make it persistent) using Java's serialization tools.

④ When you instantiate the Bean again, it will retain its properties from when it was made persistent.

Beans start life as .class files; they can then be easily instantiated and made persistent.

The latter method is preferred. In order for this to work, the Bean must have a null constructor—that is, a constructor with no parameters.

Why are there two ways to create a Bean? Because a new object is not always a new object when it's a Bean; Beans can be resurrected from a persistent data stream. If you are actually creating a new Bean and you know for sure that there's no possibility of there being a saved version, then you can use the `new` instruction. In a normal case, though, you should use the `instantiate` method because it gives the system's infrastructure the chance to use a template-serialized Bean or the `new` instruction as appropriate. Using the `instantiate` method creates a Bean using the default constructor and then restores its state data to the way it was when it was stored.

Why is this a big deal? Because Beans are meant to be reused with as little programming as possible. If you're a solution provider and have a set of JavaBeans that you supply to your customers, you can use templates effectively.

For example, you can create your Beans with a particular look and feel (e.g., a nice shade of blue with a company logo). When you supply solutions to your customers, each wants its own look and feel. All you have to do is create an instance of your components, adjust a few properties (e.g., colors and logo image), and then save them back into the JAR file (more on these later) as templates. When your customers use your components in their applications, the template versions are used, so they always see their company's own look (see the figure above).

Bean events. Beans raise events to show that something significant has happened—for instance, a button push. Other Beans might listen for certain events to know when to perform their particular action.

JavaBeans employ the *delegation* event model, which is defined in the 1.1 version of Java. Events are defined in a Java class that extends `java.util.EventObject`. Beans listen to each other by implementing a listener interface and then registering themselves with a source of events. In practice, the visual application builder usually creates this listener-interface implementation.

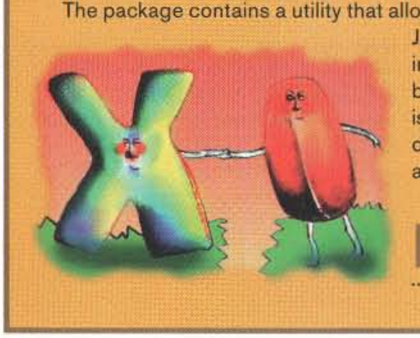
continued

BRIDGING BEANS AND ACTIVE X

While JavaBeans might be the greatest thing since sliced bread, the reality is that the dominant desktop environment and some of the major applications designed for it are built to use ActiveX components. Thus, JavaBean developers have been quick to provide a solution: the JavaBeans bridge for ActiveX.

This solution enables any JavaBean to be used as a first-class ActiveX component—that is, it lets you mix JavaBeans with ActiveX components. The bridge run-time looks to the system like an ActiveX control, while at the same time giving the Bean a Java environment.

The package contains a utility that allows the capabilities of a JavaBean to be expressed in terms of OLE-type-library and Windows-registry information. After the definition of the Bean is added to the Windows system, programs can create instances of it, and tools such as Visual Basic can interrogate its properties. The bridge run-time code then provides the mappings among the JavaBean, OLE events, and method calls so that everything is transparent to both the user and the JavaBean. This is significant: Creators of JavaBeans don't need to know whether their Beans are in an ActiveX container. They don't have to write any extra or specialized code to enable their Beans to be used as ActiveX components.



JavaBeans also provides tools for taking existing ActiveX components and turning them into JavaBeans in the form of the JavaBeans Migration Assistant for ActiveX. The Migration Assistant analyzes an ActiveX control and provides the skeleton implementation of a JavaBean that exhibits the equivalent public interface. It isn't able to convert the implementation code to Java, but it provides a quick start.

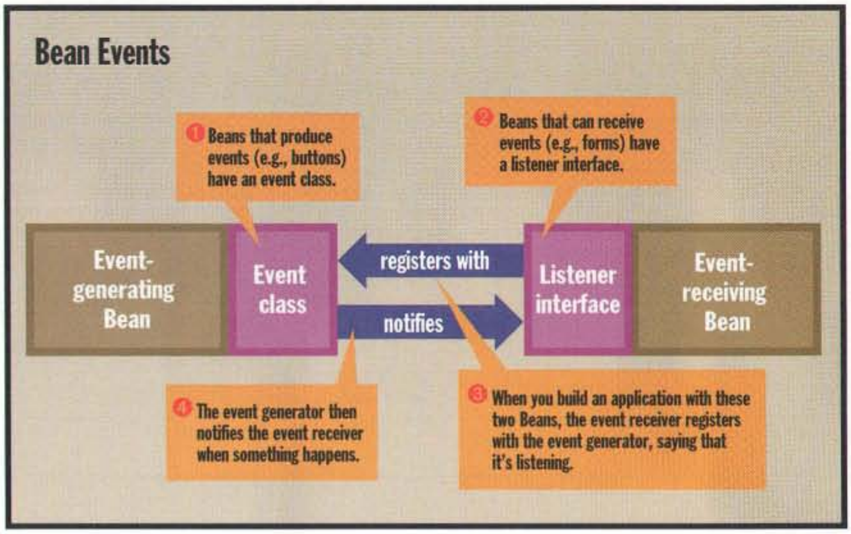
You can download the JavaBeans bridge for ActiveX from the JavaSoft Beans Web pages (http://java.sun.com/Beans).

Persistent Beans. A persistence mechanism allows a Bean or a collection of Beans to be saved in a file or transmitted across a network. Persistence enables some neat capabilities. For example, you can create a complex compound document made up of text Beans, spreadsheet Beans, chart Beans, and so on. When you attach the document to an e-mail message, the message's receiver can resurrect the document and view or edit it further—you basically send a lightweight application along with the data.

Beans use Java serialization mechanisms to provide persistence. In Java serialization, all the member variables of an object can be made persistent by the Java run-time—even whole trees or networks of objects that refer to each other. All the Bean creator needs to do is implement the `java.io.Serializable` interface. This is a simple task, as this interface contains no methods.

There is some work that needs to be done, though. Each member variable that should not, or cannot, be made persistent must be marked as transient. This instructs the serialization mechanism to ignore the field when making the Bean persistent and to create an uninitialized field when resurrecting the Bean.

Packaging Beans. You package a Bean by putting it into a JAR—a Java archive (another Java 1.1 addition). A JAR file is basically a Zip file with the addition of a *manifest*, a kind of table of contents. The JAR can contain not only the Bean's own class file but also other classes that the Bean uses, icons, graphics, internationalized text, and HTML-format help files. The whole thing can be installed or downloaded across the Web as a single HTTP request (a feature that reduces load times for Beans-based applications and applets).


Bean Events
① Beans that produce events (e.g., buttons) have an event class.
② Beans that can receive events (e.g., forms) have a listener interface.
Event-generating Bean
Event class
registers with
notifies
Listener interface
Event-receiving Bean
④ The event generator then notifies the event receiver when something happens.
③ When you build an application with these two Beans, the event receiver registers with the event generator, saying that it's listening.

The JavaBeans event model is simple to understand.

Packaging in a JAR requires only the creation of a manifest file that indicates the name of the class that defines the Bean. Execute the JAR utility, with some suitably obscure incantations, and you're done. Unfortunately, the JAR utility is not the greatest of programs and will often just accept your command-line options, execute quietly, and then do nothing. It can take several attempts and rereads of the help information to get this seemingly simple piece of work completed.

Introspective Beans. *Introspection* refers to the way in which the public interfaces to a Bean. Methods, events raised, events listened for, and public properties can be discovered at run time. This is the information that a visual builder needs in order to be able to use a Bean. The Beans introspection mechanism builds on yet another base Java feature, *reflection*, which provides the capability to discover method information about a class. The introspection mechanism also searches for design patterns defined in the JavaBean specification so that the events raised and listened for can be deduced.

Sometimes it isn't appropriate to sim-

FUTURE BEANS

The JavaBeans 1.0 specification has been around for a while, but it's still incomplete. Subsequent versions have been in the pipeline for some time. The Glasgow specification, for example, was made available for public review last September. Some of the specification's important features are as follows:

- A containment-and-services protocol that enables a Bean to discover information about the Bean within which it's contained and for the containing Bean to make services available to the Beans it contains.
- A drag-and-drop subsystem that closely integrates drag-and-drop operations with the native platform facilities. This is to permit Java and the native-platform applications that are running side-by-side on the same system to cooperate.
- An activation framework that enables applications to determine the type of and identify an arbitrary piece of data, encapsulate access to it, discover the operations that are available on it, and instantiate the appropriate JavaBeans component to perform these operations.
- Issues such as aggregation were dropped from the Glasgow specification, so we can be sure that there will be more revisions and releases beyond the current one.

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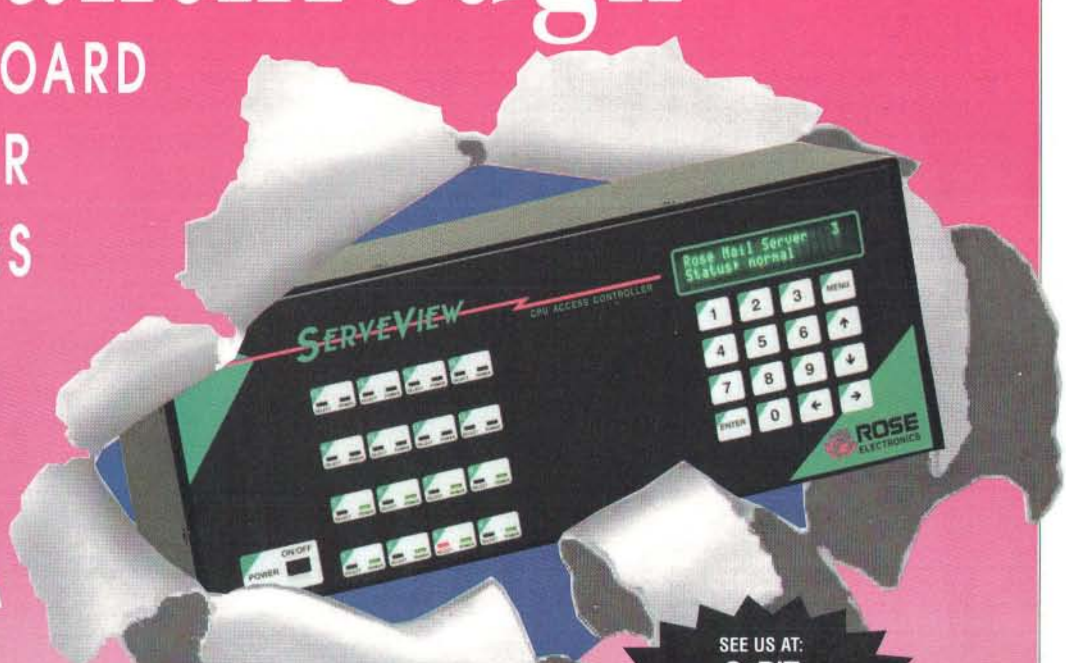

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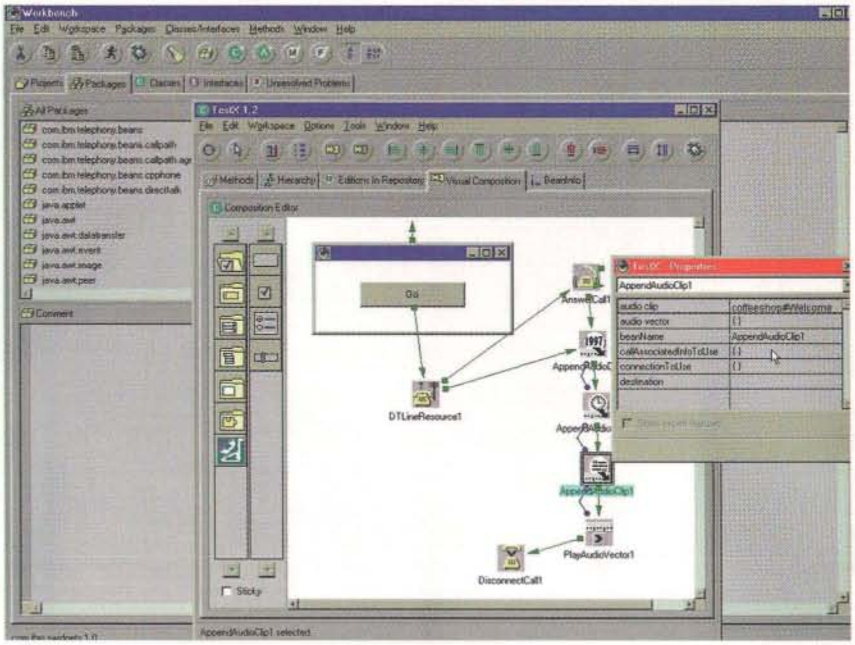
ply assume that all public methods are to be accessible to other users. You might want to explicitly specify which methods, events, and properties constitute the public interface of your component.

To do this, you create a BeanInfo class. BeanInfo allows complete control of the definition of the public interface to a Bean. If a BeanInfo class exists, it's the definitive source of interface information, and no attempt is made to use automatic introspection mechanisms. BeanInfo hides methods and properties even if they are accessible through public methods at the Bean-class level. This means the Bean can present one view of itself in an application builder and another when used as a simple Java class.

In addition, and very important, BeanInfo allows the reuse of Java code not originally designed as a Bean. Often, existing code does not abide by the JavaBeans design patterns that identify public properties. A BeanInfo class can specify the names and types of a property and define the "getter" and "setter" method names. (You still have to provide code for the other features, such as persistence.)

These five features are the fundamental ones that most Beans define, although more complex Beans might define more exotic ones, such as customization or property editors. This might sound like a lot of work, but the use of a smart development environment can create the constructor, BeanInfo, and property fields; accessor methods; and JAR files with little effort on the part of the user.



AppendAudioClip1

audio clip	coffeeshop#Welcome
audio vector	{}
beanName	AppendAudioClip1
callAssociatedInfoToUse	{}
connectionToUse	{}
destination	

A look at IBM's VisualAge for Java, showing the visual builder and the workbench.

Beans Everywhere

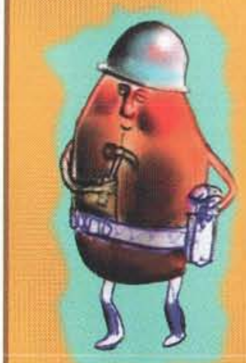
JavaBeans are not just execution-platform independent; they're also creation-platform, assembly-platform, and reuse-platform independent. You can build a JavaBean on one development platform and then assemble it into a solution using a different platform. Other users can reuse and extend your Bean using other tools running on other platforms. And the solutions that use the Bean can be deployed and executed on any Java platform. This is true platform independence; no other component model comes close to it.

It's obvious why a JavaBean is independent of its execution platform: It's Java. But how is it able to declare independence from the development environment? Introspection and customization.

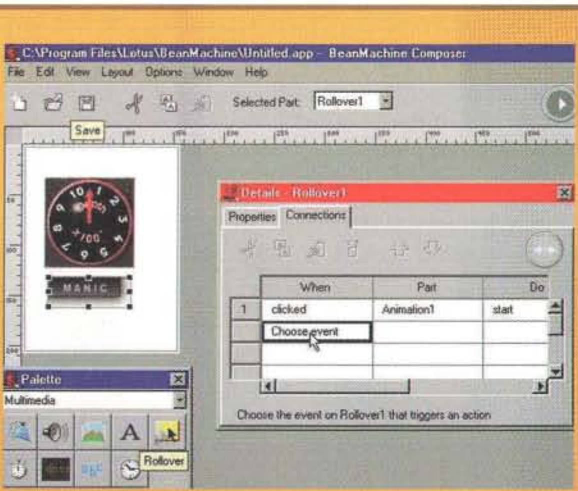
With a typical programming environment, you purchase your development tools and install them on your system

BEAN BUILDERS

In the JavaBean world, there are many different styles of Bean-capable tools. The JavaSoft Beans Web pages contain a list of two dozen or more tools, either currently shipping or scheduled to be available shortly, that support JavaBean components. Included are the traditional IDE-style builders, such as VisualAge for Java, from IBM; JBuilder, from Borland; and Java Workshop, from Sun Microsystems.



A large portion of Java code is contained within applets that are embedded in HTML pages. For the Web-page builder or publisher, there are tools such as BeanMachine, from Lotus, and Java Studio. These tools offer palettes of Beans and drag-and-drop or spreadsheet-style interfaces, which make it simple for nonprogrammers to create applets from JavaBeans.



C:\Program Files\Lotus\BeanMachine\Untitled.app - BeanMachine Composer

Selected Part: Rollover1

Details - Rollover1

	When	Part	Do
1	clicked	Animation1	start
	Choose event		

Choose the event on Rollover1 that triggers an action

Constructing an applet with Lotus BeanMachine is mostly a drag-and-drop process.

(burning up acres of hard disk space in the process). After installation, you have a large library of classes and components available to be reused. The catch is that once you build a new component using a particular development environment, it isn't always easy to use or extend from within another environment. This is because each development environment creates its own protocols for event handling, property setting, and so on—something that needs to be common among all components. In addition, the underlying support classes for each environment are often delivered as DLLs and are invariably different for different tools, so a component from one environment needs access to these classes wherever it goes.

The JavaBeans specification carefully details the event model that Java components are supposed to use when they are connected to each other. This means that whatever environment a Bean is built in, it can always raise and receive events from other Beans. In addition, JavaBeans use only the standard Java class libraries, so they have no hidden run-time dependencies. Thus, two potential major problems with JavaBeans are avoided.

Further, the Introspection mechanism of JavaBeans allows a builder environment to query everything about the run-time interfaces of a Bean. That means a JavaBean-capable development environment can accept and use any Bean.

Enterprise Beans

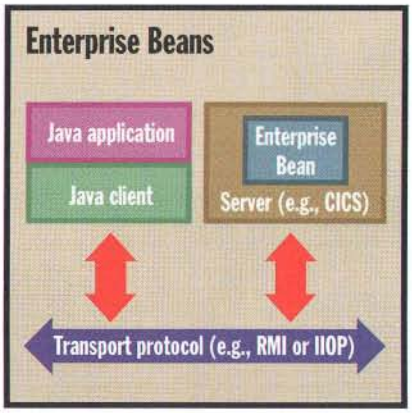
Probably the single biggest advantage of JavaBeans as a component model is its truly platform-independent nature—not only in terms of the execution platform, but also with regard to the development environments. And this isn't just a promise of future independence; it's a reality today on the platforms that now support the business systems of the world. The Java environment has become available on an enormous array of platforms in an extremely short period of time.

From the start, JavaBeans have been expected to be used not just in client systems but in back-end servers as well. The next wave of JavaBean technology will include extensions specifically targeted at these server systems.

Thus far, I've talked about building Beans. But what can you do with them? Obviously, they make great components for building user interfaces (just as ActiveX controls do). The newest wave of JavaBeans technology, called Enterprise JavaBeans, includes extensions specifically targeted at these server systems.

An Enterprise JavaBean is an encapsulation of a piece of business logic. It can be executed in an environment that supports transaction-processing constructs. In fact, current transaction-processing environments, such as IBM's CICS, will support Enterprise JavaBeans in the future.

The basic structure of an Enterprise JavaBean is the same as that of any other Bean, but with a few wrinkles. First, the Enterprise Bean comes in a JAR, but with more information that defines its transaction-scope rules. The basic model for the Enterprise Bean is one of client and server, where communication between the client application (probably built with conventional Beans) and the Enterprise Beans executing in the server is via remote method invocation (RMI), the CORBA Internet Inter-ORB Protocol (IIOP), or the forthcoming RMI over IIOP.



An Enterprise Bean functions over a network in a transactional environment.

For transaction-processing monitors to provide Enterprise Bean support, these Beans will likely have to abide by further rules that limit the things they can do. For instance, they have no AWT capabilities, so they are invisible Beans. Also, to ensure that Enterprise Beans cannot cause deadlocks or denial-of-service attacks within the server, the use of threads and synchronization will be limited. These are the kinds of limitations that current applications live with in transaction processors, so they shouldn't cause great problems; after all, this is a specialized environment.

Choosing Beans

People in the computer industry have been talking about the great advantages

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of software components for years, if not decades. Many developers already experience these advantages when they build applications with ActiveX controls.

However, selecting a component model for the creation of client-side applications has many implications, not the least of which is platform dependence. If you choose ActiveX as the client in a multitiered distributed-object solution, you have to grapple with introducing ActiveX-capable systems in many places. You must ask questions such as: How many of my existing systems support ActiveX technologies? How much will it cost to replace these systems with ActiveX-capable systems? Will I be choosing the appropriate hardware and OS platform for my solution, or is the choice of component model giving control to a single supplier? Do I want this kind of platform lock-in?

Heterogeneous networks of systems are a reality in today's business environment, yet the selection of the wrong component model for the client in an *n*-tiered solution could force a corporation to spend millions of dollars changing its back-end systems.

JavaBeans is not just a component model for the client; it holds the key to integrated, *n*-tiered solutions using the diverse array of platforms that make up today's critical business systems. In this light, the advantage of JavaBeans is obvious: platform independence—independence from the development platform, independence from the execution platform, and independence from development tools. **B**

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David S. Renshaw is an object-technology specialist at the Centre for Java Technology Development at the IBM U.K. Laboratories (Hursley Park, Winchester, U.K.). You can reach him c/o **editors@byte.com.**

The Internet Reinvented

Tomorrow's Net, driven again by researchers and academia, will include new backbones, new protocols, and new applications.

By Daniel P. Dern and Scott Mace

Today's Internet, while faster than ever before and bigger each month than the previous month, is still so slow and otherwise inadequate that an army of expert minds is determined to reinvent it.

Despite broadband backbones in the OC-12 (622 Mbps) range, end-to-end throughput on the public Internet has been measured between LAN-based workstations at as little as 40 Kbps—the equivalent of what a pair of modems could do and slightly slower than the original ARPANET, a pre-Internet backbone running at 56 Kbps.

For people in the research and academic arenas, this bandwidth and its unpredictable availability are insufficient to support many of the new applications they want and need. In many cases, without adequate networking, they will be forced to buy rather than share very expensive equipment, such as high-voltage electron microscopes. Or they may have to travel to California-Berkeley's Spectro-Microscopy Lab and witness real-time presentation of large data sets from projects such as the University of Michigan's Upper Atmosphere Research Lab.

It isn't simply a question of "more bandwidth, please," either. Today's Internet does not support other features that are as essential to the next generation of networked applications as higher speeds are.

The current Internet delivers what's called best-effort service. Version 4 of TCP/IP, which is what runs on the Internet today, has no provision for specifying or guaranteeing quality-of-service (QoS) attributes and levels for these attributes. IPv4 also can't reserve bandwidth, assure maximum network latency, or provide adequate security.

Universities and research institutions need these features today. The corporate and consumer worlds have begun to feel the need and see the value for such capabilities in the commercial Internet as well.

Getting to this next-generation Internet requires a new generation of hardware (e.g., switches and routers) and carrier services. It also requires new protocols, new network management tools, and a deeper understanding of the network needs of high-performance applications. It will need major project and program management to deploy and coordinate these changes without disrupting existing Internet service. Ways are needed to make the new capabilities available to users and their applications in a simple, easy-to-specify-and-use fashion—plus educating and training developers and users.

Such a daunting task is beyond the scope of any one vendor, university, or government agency. But it's not beyond the scope of lots of these, working in teams—and that's what's happening.

Paving the Way

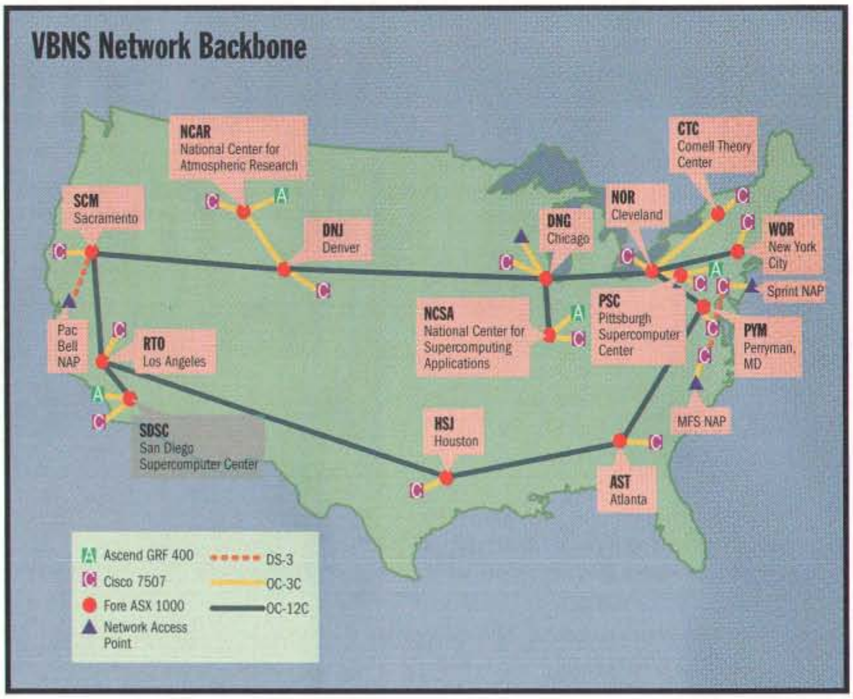
U.S. educational communities have been working together for more than a decade

ILLUSTRATION: DOUGLAS FRASER © 1998

to articulate their networking needs. Several interrelated initiatives are under way that will pave the way—and begin to construct—seminal pieces of the next iteration of the Internet. These pieces include:

- The White House's Next-Generation Internet (NGI) initiative
- The National Science Foundation's (NSF) Very High Bandwidth Network Service (VBNS)
- Internet2, an effort of a consortium of universities working with corporate and government partners
- IPng, the next generation of the Internet protocol, aka IPv6

Together, these initiatives are shooting to yield new protocols, new hardware, new software, new knowledge, and new network test-beds demonstrating applications that make use of their capabilities.



The Very High Bandwidth Network Service (VBNS) system already has 14,000 miles of OC-12 links.

NGI

NGI is a White House multiagency initiative that was announced in October 1996. Arising from the High-Performance Computing and Communications initiative, NGI is now part of the U.S. government's Large-Scale Networking initiative. The NGI program will be coordinated in the framework of the National Science and Technology Council. High-level strategy will come from the Committee on Computing, Information, and Communications (CCIC), and implementation strategy from the Large-Scale Networking Working Group.

By last fall, researchers were already demonstrating five "precursor applications." NGI includes research into protocols, development, and deployment of high-end test-beds, plus demonstrating applications. It is meeting some of these goals through Internet2 and/or VBNS.

Of all the initiatives, NGI is the one most on the cutting edge, especially its Class 1 networks funded by the Defense Advanced Research Projects Agency (DARPA) and the Department of Defense (DoD), where the network technologies proper are being tested. Some of these networks aren't even married to TCP/IP. They include:

- Collaborative Advanced Interagency Research Network (CAIRN) offers researchers nationwide a suite of Ascend Gigarouters for experimentation with RSVP, multicast, and other IPv6 protocols.
- The National Transparent Optical Network Consortium (NTONC) plans to build a $40 million prototype network in California to serve as a test-bed and evaluate the performance of advanced optical communications components. These technical advances are expected to lead to a network that can carry 10 to 100 Tb of data per second, a capacity well beyond anything currently planned.
- The Multiwavelength Optical Networking (MONET) network, stretching from Washington, D.C., to New Jersey, aims to figure out how to build a multiwavelength national optical network.
- Advanced Technology Demonstration Network (ATDNet) initially is an OC-48 (2.4 Gbps) network in the Washington, D.C., area. It was created to allow federal agencies to deploy emerging asynchronous transfer mode (ATM) and Synchronous Optical Network (SONET) technologies.
- The Advanced Communications Technology Satellite ATM Internetwork connects several DoD High-Performance Computing centers (a subset known as the Defense Research and Engineering Network [DREN] test-bed) and the Multi-dimensional Applications Gigabit Internetworking Consortium (MAGIC) and ATDNet gigabit test-beds. Research topics include network signaling, congestion management, ATM and IP multicast, and gateways to non-ATM LANs.

A key NGI goal is to develop and demonstrate two test-beds that are, respectively, 100 and 1000 times faster than today's Internet in terms of end-to-end performance—meaning about 100 Mbps and 1 Gbps. Network services that NGI will be working on include areas such as transaction security and network management. Much effort is being put into making use of off-the-shelf products and services where they exist, and to making NGI easy for companies to work with. As of last fall, more than 150 Silicon Valley companies were involved as partners.

VBNS

Before NGI, before Internet2, the NSF already was working to provide its constituency with networking beyond what the commercial Internet could deliver. The NSF's answer was to begin a dedicated network, VBNS, to provide next-generation network service to qualified researchers and academic users.

In the spring of 1995, the NSF made a five-year cooperative agreement that was worth up to $50 million with MCI for VBNS. The network, which has been operational since April 1995, links five NSF

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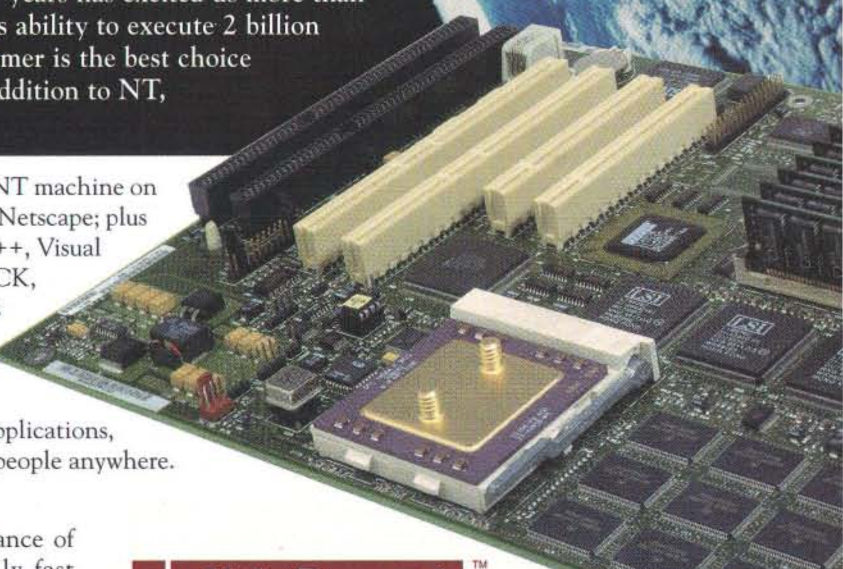

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supercomputer centers, at locations including the Cornell Theory Center and the National Center for Supercomputing Applications (NCSA). Over time, this will spread to about 100 research institutions.

As of last fall, "the VBNS includes 14,000 miles of OC-12 links, and we also offer switched virtual circuits [SVCs]," says Charles Lee, VBNS program manager in MCI Internet engineering at MCI Telecommunications. "So two sites can signal directly into MCI's ATM switches and go directly through the MCI network using Layer 2 end to end without any routers in between.

"It's an incubator for the development of next-generation applications," Lee says. "You must break the chicken-and-egg cycle—nobody will develop the applications with a network, and vice versa. VBNS is a springboard to the next generations of technology."

MCI is trying to bring native IPv6 to VBNS by March, but this may be subject

Technology the Next Internet Needs

Today's Internet is bursting at the seams. The original design never considered its current size and popularity. In many ways, it falls far short of the needs of a modern internetwork. The architects of the Internet never considered issues of data security or enormous growth.

Network Scalability: Expanded Network 128-bit Addressing

The most obvious change to the Internet protocols will be room for far more addresses than are currently supported. IPv4 has 32 bits for addressing. IPv6 will use 128 bits—enough to assign 665 septillion (665×10^{24}) addresses per square meter of the surface of the earth.

While this is far more room than we can expect to need in the distant future, in reality, 128 bits of addressing will provide only a paltry few hundred million addresses per square meter. The remaining space will be used for routing and other administrative purposes. Still, this is an expansion of the space to dimensions far exceeding our needs.

Multicasting: Making Multirecipient Flows More Efficient

The next change to the protocols will be support for data multicasting. This is a facility that lets a producer of information send only one copy out to the network, no matter how many recipients exist. The network will copy this one instance of data as needed, routing it to those hosts that require it.

Multicasting is presently being done on the Internet on a virtual subnet, the Multicast Backbone (Mbone). However, because it's within the context of IPv4 and the Internet's relatively limited speed, this is only a hint of what can and will be done with multicasting in a next-generation Internet environment.

Security: Battening Down the Virtual Hatches

Network and data security are critical issues of the next Internet. We are already seeing the effects of the current lack of strong security in such practices as e-mail and Usenet spamming, and IP address spoofing.

The IPng protocols will include two features designed to provide a higher level of communications security: an authentication header and an encapsulating security header.

The authentication header will provide a guarantee that a message has originated from a known, trustworthy source and that once in the network, you can trace the message back to its originating source. In other words, the authentication header will identify both the source of the message and the fact that the source is known and trusted. This first feature knows nothing of the content of messages, only their source.

The encapsulating security header provides a means to guarantee that messages travel intact from source to sink and that the contents of messages can be kept from the prying eyes of would-be hackers. The definition of this header supports multiple possible formats and algorithms. It is intended to be a flexible means of protecting data security and integrity, so that when new security measures become available, you can easily incorporate them into the existing model.

Quality of Service: At the Core and at the Edge

Until recently, the Internet has never had any choices in terms of quality of service (QoS) offered from providers, or that users could request—and pay correspondingly more or less for—on a basis such as per application, session, time, or parties involved. For example, there's never been a "Charge me more, give me better service" icon on-screen, nor a way to say, "Give me guaranteed toll-quality voice and video for all calls from my thesis advisor, but only low-grade, cheap quality for calls from friends unless they're paying for it." Individual ISPs such as Uunet and BBN/GTE are beginning to offer some forms of guaranteed service, but a lot's still not possible with today's protocols.

Different types of applications and different circumstances have different priorities in terms of QoS. For example, real-time voice can tolerate some loss of the signal better than delay, while real-time data may tolerate either some or no "jitter"—varying delay—but usually needs 100 percent accurate delivery.

As packets flow to their destinations, several characteristics must be guaranteeable and controllable, including:

- Capacity—If an application requires 10 Mbps from point to point, it must be able to reserve network capacity in support of its needs.
- Managing packet loss—If packet loss cannot be avoided, what level is acceptable to the application's needs?
- Packet timing—When must the packet become available for the application? What timing constraints are acceptable?

Similarly, when packets arrive at their destinations, what characteristics must be controlled?

- Admission control—What packets are allowed to enter the edge? At what layers does this become an issue?
- Packet discrimination—Are some packets more important than others? Can we route packets to application destinations based on their contents?
- Accounting and billing—Who will pay for packet transfer, and how will we track usage?

The State of IPng

The Internet Engineering Task Force is developing IPng. The IETF is a loose confederation of computer researchers and other interested parties, and is the source of all official Internet standards. It will deploy IPng, in one form or another, sometime after 1999. The problems this poses are not small.

There has been much consideration of a phased rollout, where the underlying backbones are converted to IPng before the rest of the network. If this happens, the current computers at the edge of the network will communicate through IPv4 tunnels in the new IPng network.

The largest current test-bed for the IPng protocols is a network of research and commercial sites in 29 countries called the 6-Bone. In the U.S., IPng is also being run on VBNS.

Robert Raisch *is an on-line business strategist (raisch@internautics.com).*

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to shipment of software that supports IPv6.

By June, MCI hopes to bring up reserved-bandwidth services. "Our initial QoS offering adds a reserved-bandwidth service to traditional IP datagram forwarding," Lee says. "This is for applications that need a high bandwidth with assurances of very low loss or delay. It sets up, on a per-application basis, a special path through the Internet, by signaling from the end system using RSVP, and one of our VBNS routers will translate that into an ATM virtual circuit."

The reserved bandwidth is important, Lee points out, "for when the commercial services can't support it end to end." Similarly, using Protocol-Independent Multicast (PIM) is enabling otherwise infeasible activity such as interconnecting to CAnet, Canada's big research network, to provide IP multicasting.

Although you can currently use the Multicast Backbone (Mbone) for voice and video, "that's generally done by using special routers or workstations to do tunneled IP," Lee says. "The Mbone is basically a low-performance multicast overlay. PIM on the VBNS does it with high performance."

By the end of this year, MCI plans to further enhance VBNS with source-based routing, with more than 100 domestic connections and approximately 20 international connections. And by 2000, VBNS backbone speeds should be up to OC-48.

"We can do very-high-speed wave division multiplexing (WDM) and get very-high bandwidth," says Rick Wilder, senior manager of Internet technology at MCI. "We have some 40-Gbps legs, and in our Reston, Virginia, lab, we have the new Cisco 12000 series routers that are built to accommodate OC-48. But you need to be able to plug it into something, and at present, OC-12 is state of the art in terms of what you can buy in IP routers or ATM switches that's reliable."

(WDM involves packing multiple optical-transmission streams into one fiber by sending each stream on a separate color channel.)

Meanwhile, VBNS-related activity has already borne fruit. MCI developed, and is sharing information on, a monitoring capability that lets the company look at the IP traffic inside cell streams as they flow past at high speeds. This is the first technology transfer MCI can point to from the VBNS effort.

VBNS will also be a part of the NGI efforts, providing a place for testing new applications and trying out cutting-edge network technologies.

The Proposed NGI Time Line

Initiative Deliverables	Expected Date
100+-site high-performance test-bed providing OC-3 (155 Mbps) connections over an OC-12 (644 Mbps) infrastructure	1999*
Federal, academic, and industry partnerships conducting applications/networking research on the 100× test-bed	1999
10+-site ultrahigh-performance test-bed providing OC-48 connections (2.5 Gbps)	2000
Tested models for NGI protocols, management tools, QoS provisions, security, and advanced services	2000
100+ high-value applications testing and benefiting from a high-performance test-bed (e.g., remote, real-time, collaborative NGI network control of selected laboratories)	2000
Consortium conducting networking/applications research on the 1000× test-bed	2001
Ensure interoperability across multiple carriers among 100+ lead users tested for reliable data communication	2001
Tbps packet switching demonstrated	2002
10+ advanced applications testing and benefiting from ultra-high-performance test-bed	2002

* All dates are fiscal years starting the prior October 1.

Internet2: Academia's Next Stand

After VBNS took flight, universities agreed to pool their resources for a new level of internetworking. The result was a project that was dubbed, misleadingly, Internet2. This was misleading in that although it was in pursuit of next-generation Internet technology, it was not intended to replace the existing Internet, nor to build a new network for general users.

UCAID, the University Corporation for Advanced Internet Development, was formed in September 1997 to manage Internet2 and to assist other consortia, such as North Carolina's Gigabit Point of Presence, also known as a GigaPOP (see the figure "The U.S.'s First GigaPOP" on page 96). GigaPOPs will help aggregate traffic from universities, avoiding many of the problems created by the architecture of today's Internet Network Access Points (NAPs).

Nine of UCAID's corporate members—Advanced Network and Services, Bay Networks, Cisco Systems, Fore Systems, IBM, Newbridge Networks, Nortel, Starburst Communications, and 3Com—have joined at the partner level. This means that they have committed to contribute more than $1 million each to Internet2 over the course of the next three to five years.

"When NSF started privatizing, there was a view that our troubles would be over," says Mike Roberts, vice president of Educom, a Washington, D.C., consortium of 600 colleges with interests in information technology for education.

"But we didn't get enough attention in terms of how to arrange for the continuing evolution and for the introduction of new technology into the Internet usefully incorporated. We missed that.

"And we also failed to understand that the private sector, the folks buying up regional nets, the ISPs, would have to concentrate on the bottom line ... and that automatically meant that the 'center of gravity' in what they would do to enhance technology would be slower than the research institutions would want."

Internet2, VBNS, and NGI are also interrelated, although Internet2 and VBNS have self-contained missions of their own, independent of NGI or each other. At present, VBNS provides backbone network service for Internet2. Internet2 and UCAID are also providing some of the participation by the higher-education arena in the NGI effort. Indeed, Internet2 is seen as fulfilling the first goal of the NGI program, hooking up the 100 top universities and

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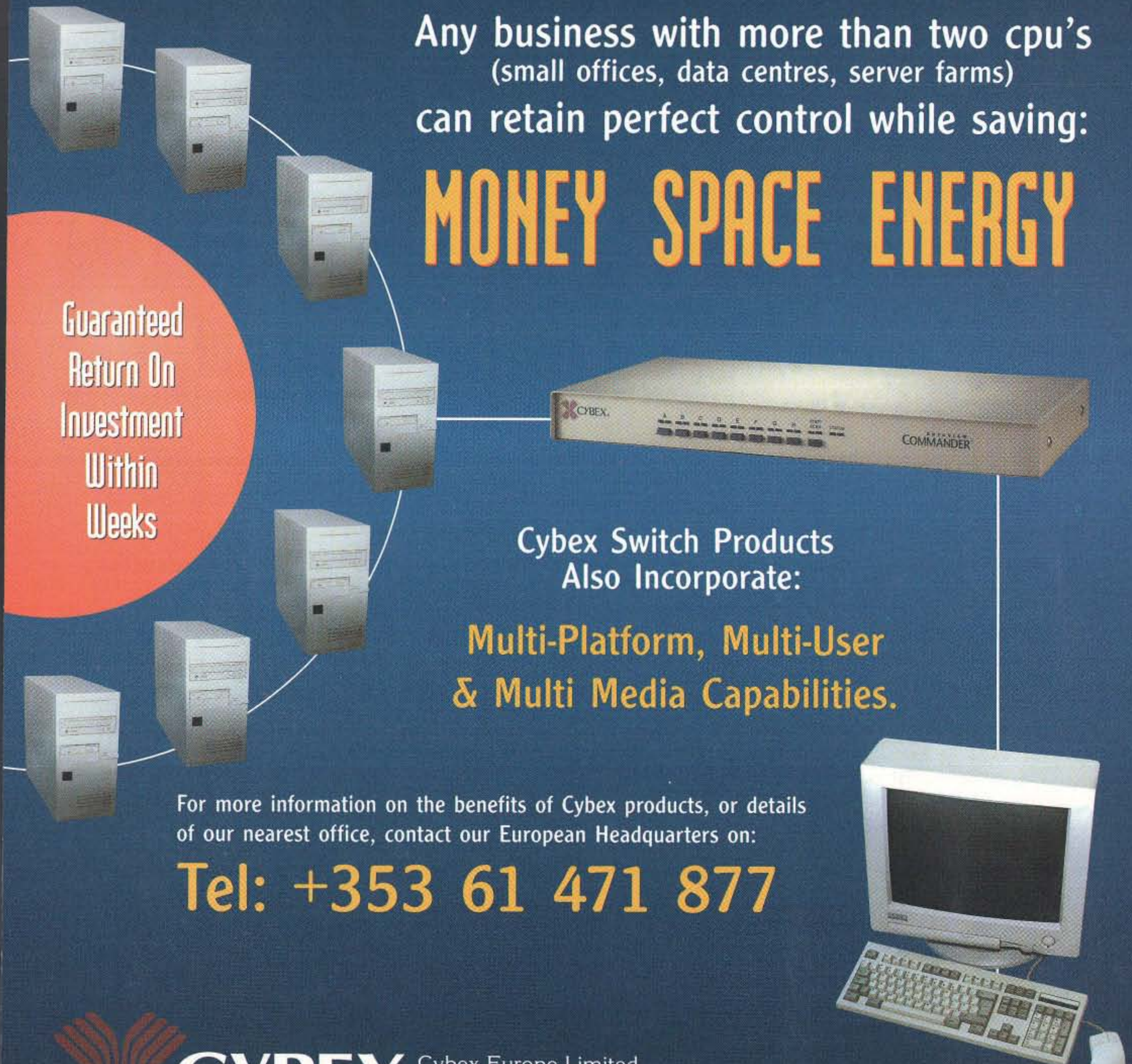

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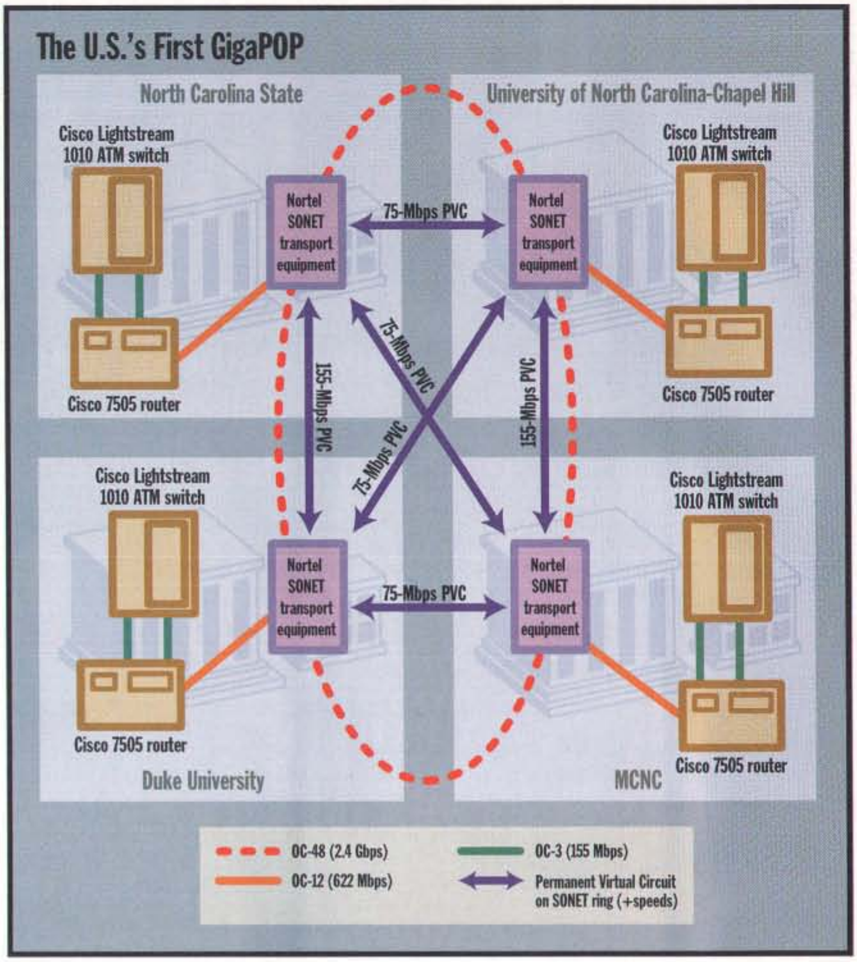

The U.S.'s First GigaPOP

North Carolina State
University of North Carolina-Chapel Hill
Cisco Lightstream 1010 ATM switch
Cisco Lightstream 1010 ATM switch
Nortel SONET transport equipment
75-Mbps PVC
Nortel SONET transport equipment
Cisco 7505 router
155-Mbps PVC
75-Mbps PVC
75-Mbps PVC
155-Mbps PVC
Cisco 7505 router
Cisco Lightstream 1010 ATM switch
Cisco Lightstream 1010 ATM switch
Nortel SONET transport equipment
75-Mbps PVC
Nortel SONET transport equipment
Cisco 7505 router
Duke University
MCNC
Cisco 7505 router
OC-48 (2.4 Gbps)
OC-12 (622 Mbps)
OC-3 (155 Mbps)
Permanent Virtual Circuit on SONET ring (+speeds)

North Carolina's Gigabit Point of Presence (GigaPOP) aggregates a variety of traffic onto a single high-bandwidth link.

Internet2's plans call for operational testing by the fall of this year, although, using VBNS, some applications have already been demonstrated, including some at meetings that were held in Washington D.C., last fall. Internet2 applications cut across all academic disciplines. Some will be collaborative environments, and others will be digital libraries. Some will facilitate research, and others will enable distance learning.

Internet2 also provides a place to test various policy issues, such as how to cost and charge for bandwidth reservation. It's also a place to experiment with ways to leverage the GigaPOPs, such as with local caches and replicating servers, and satellite up- and down-links to improve network efficiency.

Besides the remote instrumentation mentioned earlier, collaboration environments will allow for audio, video, text, and whiteboard discussions in real time. Other applications support new forms of collaboration through 3-D virtual shared presences known as immersive environments. Finally, telemedicine, including remote diagnosis and monitoring, will get a boost from Internet2.

Intensively interactive graphical/multimedia applications are also prime candidates for NGI, involving things like rich scientific visualization, collaborative virtual reality (VR), and 3-D immersive environments, with names such as computer-assisted virtual environment (CAVE); CAVE research network (CAVERN); ImmersaDesk; Narrative, Immersive, Constructivist/Collaborative Environment (NICE); and Tele-Immersion (combining networked VR and video with a lot of computing and data mining).

Although the original Internet2 organizers thought that fewer than two dozen schools would need to be part of the new network, as the word spread, pretty much every major research university in the U.S. "wanted in," according to Roberts—114 in all.

To participate, each university had to commit up front to half a million dollars to pay for their upgrade of the WAN, to pay $25,000 a year to the central group to cover coordination costs, and to create at least one new application.

Terabits to Come

Unsurprisingly, the research community continues to look ahead to still-faster networks to put to use. Educom's Roberts reports there is discussion of an OC-192 (which is nearly 10 Gbps) network for highly qualified researchers, of which there are between 50 to 100.

"Cutting-edge deployers are already providing 40 to 60 Gbps in a single fiber ... and the theoretical limit of a fiber is 100 Tbps," says Craig Partridge of BBN/GTE—2000 times more than the current delivered capability and 100 times more than the lab limit.

"That could carry us perhaps for another decade, depending on how things grow ... and, of course, we'll also be laying more fiber," Partridge says. ■

WHERE TO FIND

CAIRN—Collaborative Advanced Interagency Research Network
http://www.cairn.net

Internet2
http://www.internet2.edu

Multiwavelength Optical Networking (MONET)
http://www.bell-labs.com/project/MONET/mon_pro.html

Next-Generation Internet (NGI) Initiative
http://www.ngi.gov

NTONC—National Transparent Optical Network Consortium
http://www-phys.llnl.gov/H_Div/photonics/NTONC.html

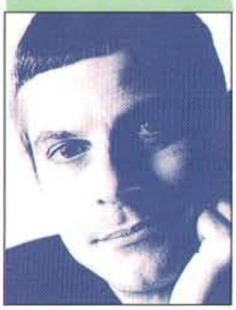
UCAID (University Corporation for Advanced Internet Development)
http://www.ucaid.edu

VBNS
http://www.vbns.net

Daniel P. Dern writes about the Internet and other technologies. You can contact him at the following: **ddern@world.std.com** *or* **http://www.dern.com**. *Scott Mace (***smace@byte.com***) is a BYTE senior editor located in San Mateo, California.*

Jon Udell

Web Project

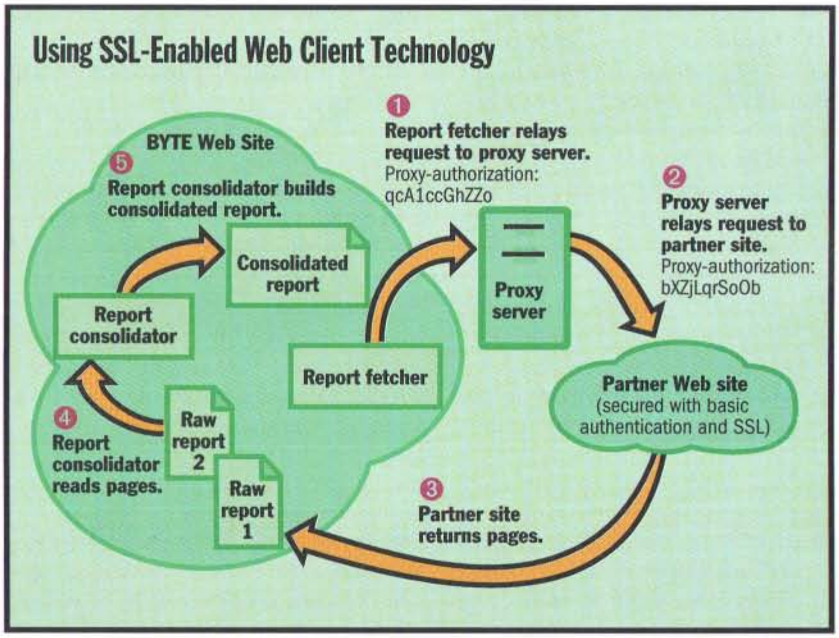


In Search of SSL Spidering

Building tools that fetch and process secure pages, I learn some painful lessons about WinInet and SSLeay.

In "On-Line Componentware" (November 1996 BYTE), I pointed out that every Web site is a large-scale component that can call, and be called by, other Web-based components. The example I gave in that column was Metasearch. It was a BYTE Site script that used Web-spidering technology to search AltaVista for articles in BYTE and other McGraw-Hill magazines. AltaVista itself, of course, used the same kind of technology to index our sites.

I was amazed to discover that peer-to-peer networking of Web sites was not only possible, but downright simple. This month, I'll show how we use this technology to monitor our own site and to extract information from a secure server at a partner's site.


Using SSL-Enabled Web Client Technology
BYTE Web Site
⑤
Report consolidator builds consolidated report.
①
Report fetcher relays request to proxy server.
Proxy-authorization: qcA1ccGhZZo
②
Proxy server relays request to partner site.
Proxy-authorization: bXZjLqrSoOb
Consolidated report
Report consolidator
Proxy server
Report fetcher
Partner Web site
(secured with basic authentication and SSL)
④
Report consolidator reads pages.
Raw report 2
Raw report 1
③
Partner site returns pages.

When business-to-business networking relies on secure channels, integrators need SSL-aware Web-spidering tools.

Dave's Site Monitor

The BYTE Site is a cluster of Windows NT and Unix machines that provides a growing number of public and private services. A while ago, I realized that we needed a unified way to monitor the health of these services. I also realized that the many Web servers, FTP servers, NNTP servers, and mail servers that we operate do not in themselves define the list of services that users expect us to support.

For example, our search server runs two search engines in parallel—SWISH and Excite. It's not enough to know that the NT 4.0 machine that hosts these engines is healthy, or even that the Internet Information Server (IIS) 3.0 Web server on that machine is alive and kicking. What matters to users, ultimately, is whether SWISH and Excite are working as advertised.

By a happy coincidence, the two properties that make each of our services available to users—a URL and a corresponding Web page—are just the things you need to build a robotic tester. I put the challenge to my associate Dave Rowell. The screen on page 98 shows the incredibly useful solution Dave came up with.

Our site monitor is a Perl script, scheduled to run every half hour, that's driven by a table of address/result string pairs. One of the addresses is our home page, http://www.byte.com/, and the corresponding result string is a piece of text that appears on that page.

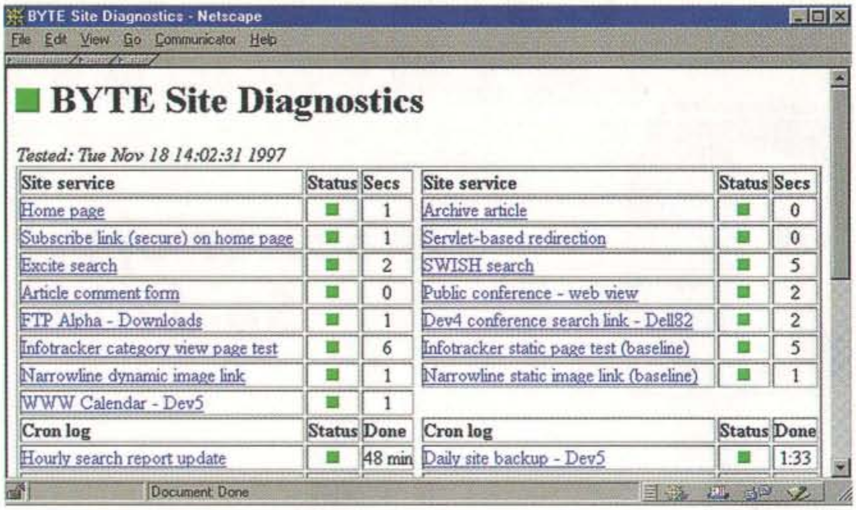
The monitor fetches the page, and if it contains the expected result string, that test produces a green-light icon. If the home page takes longer than expected to arrive, the icon will instead be yellow, and the monitor may or may not issue an alert, depending on how we have configured the alarm threshold. If the home page never arrives, the icon will be red—and in that case, the monitor will send e-mail to the new media team and to my pager.

There's more to the monitor than Web-page fetching. It watches the free space on various drives. It checks to see that log files expected to have been written by scheduled backup processes were, in fact, written. We'd like to add a module that pulls log entries from key systems—both NT event logs and Unix syslog files—and reacts to anomalies that would be defined in the monitor's configuration file. But if you strip away all the bells and whistles, what's left is a table-driven automatic

PHOTOGRAPH: KELLIE WALSH © 1998

URL fetcher that alerts you when static or dynamic pages arrive slowly, incorrectly, or not at all.

This tool has revolutionized our ability to monitor the health of our site, and we've come to depend on it. Therefore, it was a matter of some concern when, a few weeks ago, the monitor began issuing a stream of spurious alerts.


BYTE Site Diagnostics - Netscape
File Edit View Go Communicator Help
Document: Done

■ **BYTE Site Diagnostics**

Tested: Tue Nov 18 14:02:31 1997

Site service	Status	Secs	Site service	Status	Secs
Home page	🟩	1	Archive article	🟩	0
Subscribe link (secure) on home page	🟩	1	Servlet-based redirection	🟩	0
Excite search	🟩	2	SWISH search	🟩	5
Article comment form	🟩	0	Public conference - web view	🟩	2
FTP Alpha - Downloads	🟩	1	Dev4 conference search link - Dell82	🟩	2
Infotracker category view page test	🟩	6	Infotracker static page test (baseline)	🟩	5
Narrowline dynamic image link	🟩	1	Narrowline static image link (baseline)	🟩	1
WWW Calendar - Dev5	🟩	1			
Cron log	**Status**	**Done**	**Cron log**	**Status**	**Done**
Hourly search report update	🟩	48 min	Daily site backup - Dev5	🟩	1:33

Dave Rowell's invaluable site monitor polls a list of URLs, times the responses, and issues alerts if pages don't arrive promptly.

Why the Site Monitor Failed

The service that the monitor thought had failed was the secure ordering system on our primary Web server. The https:// URL that defines this part of the test was triggering a red-light response. And yet, whenever we fetched that URL interactively, all was OK. Neither Dave nor I could remember installing any software or making any configuration changes on the NT 4.0 machine that hosts the monitor. What could have gone wrong?

Finally, Dave noticed that the target URL was expressed in the monitor's configuration file as an IP address rather than a Domain Name System (DNS) name. We switched to the DNS name, and that restored the errant test to green-light status. But why? That remained a mystery.

I should explain that when I proposed this project to Dave, I forgot to mention that he needn't bother trying to test the parts of our site accessed by way of Secure Sockets Layer (SSL). Not knowing that an SSL page wouldn't work, Dave included one in the tests—and to my surprise, it did work. It worked because the URL-fetching tool I recommended to him was Win32::Internet. This is a Perl module that talks to WININET.DLL.

The WinInet library comes with Microsoft's Internet Explorer (MSIE) and is also available separately as part of the ActiveX Software Development Kit (SDK). Among WinInet's functions are those that MSIE itself used to access FTP, HTTP, and HTTPS (secure) URLs. This is powerful stuff! When Microsoft introduced WinInet a few years ago, it was billed as a generic Win32 component—like ODBC, but for Internet rather than SQL data sources.

True, it came with MSIE, but many important Microsoft components have debuted in an application context and gone on to become integral parts of Windows. That Dave's monitor could quite unexpectedly fetch a secure page convinced me that WinInet was indeed, like ODBC, the kind of subsystem that makes Windows increasingly useful.

A few days later, while working on a different tool, I stumbled onto the real reason the monitor had failed. The new tool's job was to fetch reports from a partner site, over an SSL connection, and consolidate the data (see the figure on page 97). It worked on one Win32 system, but not on another. One difference between the two, I noticed, was MSIE. The tool worked on the system that had MSIE installed, but not on the one to which I had copied only WININET.DLL. Was the tool depending not only on WinInet, but also on MSIE? It was. Moreover, I found I could break the working version of this tool by twiddling settings in MSIE's Advanced Internet Options dialog box!

Armed with this knowledge, we went back to have another look at the machine that hosts the site monitor. Was MSIE installed there? Yes. Then, suddenly, I saw what had happened. Dave and I had not installed any software on the machine the day we broke the monitor, but we had used MSIE along with Navigator to try out an experimental new feature of our site.

In the process, we had visited MSIE's Advanced Internet Options screen and changed some settings. One of these was "Warn about invalid site certificates"—the setting that causes MSIE to complain if the X.509 common name in a server certificate doesn't match the host name in a request from an SSL page. What looked to us like a small reconfiguration of MSIE was, in fact, a broader reconfiguration of WinInet—and therefore of Win32::Internet and our site monitor. Call me old-fashioned, but I don't think system components ought to behave this way.

Maybe I shouldn't have been surprised. If MSIE is part of the OS, perhaps it makes sense that you reconfigure the OS when you reconfigure MSIE. There is precedent for this in Windows. In dial-up networking, for example, I can start by tweaking a particular dial-up connection and end up tweaking systemwide modem properties. Not a great idea to have set this precedent, perhaps, but there it is. What's more, MSIE's Advanced Internet Options dialog box does double duty as Settings->Control Panel->Internet, a systemwide configuration tool.

And yet, I can't help but believe there's something not quite right here. Suppose some database application came with a Settings dialog box that let you tweak the dialect of SQL spoken by ODBC—and thereby affect all other ODBC-dependent applications? Would anyone agree this is right and proper?

Further, suppose that you found it difficult to ship an ODBC application without also shipping Microsoft Access—because only interactive use of Access left the registry in a state where ODBC-based applications would work? That's essentially what I ran into when I tried to package my report consolidator, so that I could deliver it to a McGraw-Hill colleague.

Untangling the WinInet/ MSIE Dependencies

In theory, I should be able to build a version of the report consolidator that runs

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A Division of The ***McGraw·Hill*** *Companies* on any vanilla Windows 95 or NT machine (i.e., a machine with no copy of MSIE installed). In practice, I never did figure out how to do this. My WinInet-based software never seemed to behave predictably when I moved it between MSIE and non-MSIE machines.

Here's an example. At one point, I noticed that my program, if given no proxy or basic authorization credentials, would pop up a dialog box soliciting this information. Further investigation showed that only the new (MSIE 4) version of WinInet does this. Maybe I just needed to distribute the newer WININET.DLL with my standalone program?

I tried that. However, WinInet griped that it couldn't find a routine in another DLL, SHLWAPI.DLL. Should I distribute that one, too?

Clearly, I was on the slippery slope at this point. A quick Dejanews search turned up a litany of woes related to SHLWAPI, WININET, and MSIE. And, of course, since Windows locks down SHLWAPI.DLL at start-up, this wasn't going to be a smooth installation in the best of circumstances. A prospective user of my program would need instructions such as:

1. Reboot.
2. Hit F8.
3. Pick item 6 (Command Prompt) from the menu.
4. Copy a:shlwapi.dll c:\windows\system.
5. Reboot again.

Not too nice. But in the name of science I performed the experiment, and the results looked hopeful. Now WinInet had whatever it wanted in SHLWAPI.DLL. And I got a dialog box for stage 1 of authentication: the proxy server's challenge. However, at stage 2 of authentication, the final destination SSL server, oops ... error in KERNEL32.DLL.

I tried a lot of things. In addition to Perl's Win32::Internet, which apparently does not handle proxies or basic authentication in an SSL context, I experimented with a few C++ programs that use WinInet. Both worked on MSIE machines. Neither one worked on non-MSIE machines. Eventually, I gave up and went looking for some other solutions.

Alternatives: SSLeay and IAIK-SSL

My report consolidator is a two-stroke engine. First, it fetches secure pages, and then it launches Perl to consolidate the data. What's another way to do the first stroke? Browsers can fetch pages and can also behave like components. For example, you can drive MSIE or Navigator, on Windows, using OLE Automation.

BOOKNOTE

Web Security and Commerce ($32.95)

by Simson Garfinkel and Gene Spafford
O'Reilly and Associates
ISBN 1-565-92269-7
http://www.ora.com/

A helpful discussion of a wide range of issues, including encryption, SSL, certificates, Authenticode, access control, and legal aspects of cryptography.

TOOLWATCH

Hamilton C Shell ($350)

Hamilton Laboratories
http://www.hamiltonlabs.com/

All your Unix friends—csh, cron, du, ls, grep, and many more—are reimplemented in the modern, threaded style of Windows NT. These are high-quality tools for serious professionals.

However, this didn't look like an attractive option. I wasn't sure that OLE Automation could handle the authentication dialog boxes. Moreover, the process actually needs to fetch two secure pages, each requiring a different set of credentials. When you do this manually, you have to quit the browser after the first fetch, in order to reset the credentials for the second, and this stop-and-restart scenario would have to be replayed under OLE Automation.

Next I tried SSLeay, Eric Young's freeware implementation of SSL. It was a snap to build SSLeay on a Silicon Graphics Irix system, and equally straightforward to adapt sconnect, a sample page fetcher included with the kit, to handle proxies and basic authentication.

However, my colleague runs Windows 95, not Irix, so I next tried the Win32 make file included with SSLeay. It has been recently upgraded and is now as competent as the Unix version. In short order, I had a redistributable package that I could send my colleague—the SSLeay Win32 libraries, a version of sconnect, and a Perl script to consolidate the pages that were brought back by sconnect. Everything worked like a charm on a vanilla Windows 95 machine.

Unfortunately, I soon learned I could not send that package to anyone. When I went back and read the fine print, I realized I'd probably broken the law. Inside the U.S., use of SSLeay infringes patents held by RSA Data Security.

The right thing to do, according to Eric Young and RSA, is to link SSLeay with RSAREF, a reference implementation of the patented algorithms that RSA makes freely available. That's easier said than done, however.

Another alternative, which was mentioned in last month's Toolwatch, is IAIK-SSL. It's a snap to build an automatic SSL client with IAIK-SSL. But like SSLeay, this toolkit also does not use code licensed from RSA, and thus constitutes patent infringement if used in the U.S. What's more, there's no available Java counterpart to RSAREF. JavaSoft offers JSAFE, but it's pricey.

Sun's Java Electronic Commerce Framework, which is now in alpha release, is another possibility. However, it's probably overkill for simple chores such as my report consolidator. Web-spidering technology is, from a certain perspective, the ultimate middleware. Tools that enable Web spidering are simple, universal, and powerful.

Unfortunately, and for a variety of reasons, it's not straightforward to use these tools in SSL environments. I hope that this situation improves. Many of the most interesting applications on my to-do list will benefit from, if not require, secure channels.

So how did I deliver my report consolidator? Well, actually I didn't. For now, I've delivered only the Perl postprocessor; my colleague will have to fetch the pages interactively. I make the same application available to our sales staff, but without a client component. It runs on an NT server, where, provided I'm careful about how I use MSIE, I can leverage WinInet. This certainly isn't a very pretty picture. If there are better solutions, I'd like to hear about them. B

Jon Udell is BYTE's executive editor for new media. You can reach him at **jon@byte.com**.

Rick Grehan

Javatalk

The Federated Database

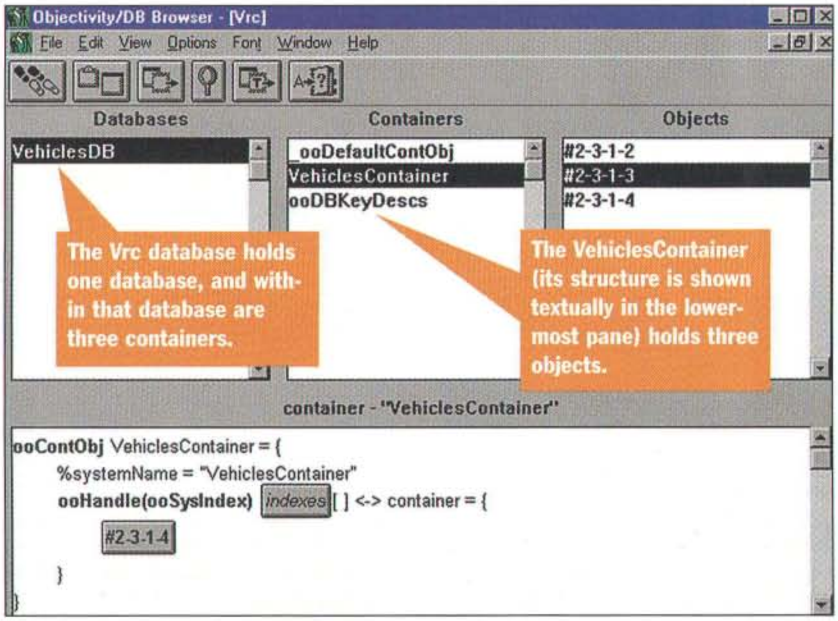
Our series on Java-based object databases continues with a look at Objectivity/DB.

For the past two months' columns, I've been reviewing Java-based object-oriented database management systems (OODBMSes). I continue this month with a look at Objectivity/DB, from Objectivity, Inc. I've been working with the beta release of Objectivity/DB version 5 for Java (developer prices range from $8000 to $12,000, run-time prices vary), running on Windows NT 4.0.

Objectivity/DB is similar to Poet (see "Poet Goes Java," December 1997 BYTE) in that an Objectivity database can be accessed either by C/C++ or Java client applications. Objectivity/DB's structure differs from both Poet and Objectstore/PSE: Specifically, Objectivity/DB is not built on a strict client/server architecture. Instead, Objectivity services are linked into the application, which accesses the actual database directly. You'd think that the result would be large applications (since code normally on the server is in the client), but Objectivity engineers report that an Objectivity application (with the "server" code linked in) is between 1 and 1.5 megabytes—not bad in this day and age.

Objectivity applications do require the presence of an Objectivity lock server somewhere on the network. The lock server doesn't perform any real database access. Instead, its job is to provide a centralized resource manager that enforces concurrency throughout the database.

"Database" is an overloaded word in the Objectivity world. What other systems refer to as a database, Objectivity refers to as a *federated database*—a collection of databases. Functionally, your application can access multiple databases simultaneously, all under control of the single lock manager. These multiple databases make up a *federation*. Most important, all the databases in the federation participate in concurrency controls. The effect is that your application can start a single transaction involving objects from multiple databases, and the coding is no more complex than had you initiated that transaction on a single database.



The Vrc database holds one database, and within that database are three containers.

The VehiclesContainer (its structure is shown textually in the lowermost pane) holds three objects.

```
ooContObj VehiclesContainer = {
    %systemName = "VehiclesContainer"
    ooHandle(ooSysIndex) indexes[ ] <-> container = {
        #2-3-1-4
    }
}
```

Objectivity/DB's browser provides a view into the Vrc federated database.

Objectivity recognizes a variety of "species" of objects. The fundamental storage unit is referred to as a *basic object*. A basic object corresponds to the classes within an application that, by being derived from persistent capable superclasses, can be stored in a database. As with Poet and ObjectStore/PSE, storable basic objects are persistent objects.

Note that some classes that are not persistent can create objects that are stored in a database as attributes of a persistent class. For example, you can use objects of the `string` class as attributes for persistent classes, and these string objects will be stored with the persistent object. But you cannot use a `string` object to create a persistent object. As it turns out, you don't simply store basic objects directly in a database; you must first place basic objects into a container object (this operation is called *clustering*). A container object acts not only as the storage framework for collections of basic objects, it also serves as the elementary locking unit within an Objectivity/DB database. If you lock an object, you lock the entire container for the object and all other objects within that container.

continued

PHOTOGRAPH: KELLIE WALSH © 1998

An application locks a container using one of two access policies: exclusive or multiple readers, one writer (MROW). The former provides strict read or write locking, such that a read lock excludes all write locks, and a write lock excludes all locks. MROW allows unlimited read locks, but only one write lock on the container (thus providing additional concurrency). Hence, you should carefully balance the structure of the overall database in terms of containers versus basic objects. Few containers, with many objects in each container, reduces concurrency because one user's lock on an object in a container locks all other objects within the container from other users. However, having many containers with just a few objects increases overhead in the database.

In addition, containers can be defined as being *garbage-collectible*: Any object within a garbage-collectible container is automatically deleted when all references to that object (from other persistent objects) have been eliminated. The converse of a garbage-collectible container is a nongarbage-collectible container. Objects within this type of container must be explicitly deleted. (Note: Here's where Java shines. Recall that Objectivity/DB supports C++ clients. However, C++ clients do not support garbage-collectible objects. The same mechanism that allows Java to garbage-collect transient objects, as part of the way that the language's environment naturally works, gives it the ability to collect persistent objects; no such mechanism exists in C++.)

As with other OO databases, all operations that perform database access must take place within a transaction. Actions on the database are not visible to the "outside world" until the transaction completes. However, modifications to the database are visible to those portions of an application within the transaction. This aspect of a transaction is referred to as *isolation*.

Any access to a persistent object within a transaction proceeds along the following steps. First, the application (with the help of Objectivity methods) creates a local (transient) representation of the object. Next, the persistent object is locked in the database (safeguarding against meddling by other applications). This locking is performed for the application on behalf of the Objectivity transaction run-time code. Finally, the actual data is fetched from the database and "poured" into the waiting transient object.

Jaguar: Java Components and Transactions

Developers interested in the pending Enterprise JavaBeans specification (still under development at the time of this writing) can get an inkling of its final form thanks to Powersoft's Jaguar CTS (component transaction server). The general-availability version of Jaguar was released last fall and, according to Jaguar engineers, tracks closely the Enterprise JavaBeans specification. That specification promises to extend JavaBeans' distribution capabilities into the realm of transaction coordination.

Jaguar is middleware, an application server. Components installed in Jaguar become usable across whatever network the Jaguar server is connected to (which can include the Internet). And the diversity of components that Jaguar supports is eye-opening: A single Jaguar server can juggle JavaBeans, classes, ActiveX controls, and even DLLs.

If component diversity is Jaguar's proudest trait, transaction management is its strongest muscle. In many ways, Jaguar is like Microsoft's Transaction Server. It removes from the developer any concern for transaction management details. Any component installed in the server is a candidate for participation in a transaction. More important, no component in a transaction need concern itself with the behavior of other components in regards to their effect on the transaction–Jaguar handles all that.

Here's an example. Suppose you have three components – A, B, and C – that you want to use in a transaction. Jaguar provides a small but versatile API that components call in order to keep the server informed of each component's transaction state. So, if components A and B succeed, while component C fails, the Jaguar server aborts the overall transaction and deals with the dirty work of issuing rollbacks on whatever database resources A and B were communicating with.

As mentioned, Jaguar is not limited to Java components. A Jaguar component can as easily be a C/C++ DLL or an ActiveX control. So, a client-side application written in Java can not only remotely invoke a JavaBean or class, it can as easily invoke a C/C++ routine in a DLL, or an ActiveX control. (Similarly, a Jaguar client could be an ActiveX control, calling a JavaBean or a C/C++ DLL.)

Jaguar comes with the necessary tools for generating the stub files needed for a Java client to communicate with a Jaguar component (regardless of the component's species). The stub files contain "mimic" methods that appear to the Java client application as the methods of the remote component. Within the stub is the code that establishes a session with the Jaguar server and commands the server to instantiate the actual component. The stub also handles the client end of marshalling the data between the client and the Jaguar server.

Pricing for Jaguar starts at $135 per seat. However, developers can get a jump-start on working with Jaguar by purchasing the $295 software development kit. This is a fully functioning Jaguar system whose only limitation is the number of simultaneous connections allowed. (For details, check the Jaguar site at http://www.powersoft.com/products/jaguar.)

Numerous options are available to enhance an Objectivity database installation. Objectivity/FTO (fault tolerant option) lets you partition a federated database into autonomous pieces so that, if a portion of the database goes down, those pieces still "alive" remain available. With the Objectivity/DRO (data replication option), you can create database "mirror images" for critical applications that cannot endure downtime. If one image goes down, the mirror takes over.

Objectivity adheres to the Object Database Management Group's ODMG-93 standard; the company has added useful extensions, such as indexes and containment iterators. Given that an Objectivity database is accessible from Objectivity "front ends" that can be Java, C++, Smalltalk, or even SQL, Objectivity/DB is a good candidate if your enterprise's database access must extend across language boundaries.

WHERE TO FIND

Objectivity, Inc.
Mountain View, CA
650-254-7100
fax: 650-254-7171
http://www.objectivity.com

Rick Grehan (**rgrehan@austin.metrowerks.com**) *works for Metrowerks' Discover Products division. He is coauthor of* The Client/Server Toolkit *(NobleNet, 1996).*

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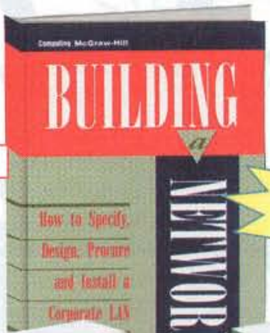
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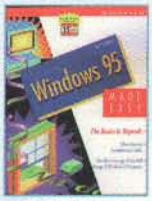
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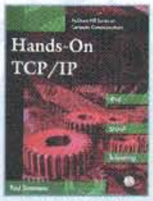
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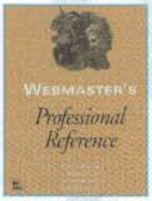
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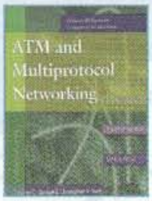
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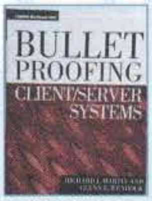
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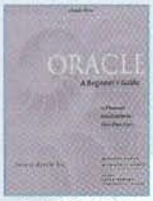
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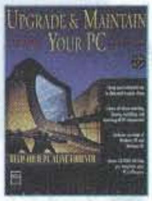
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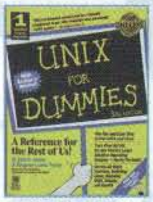
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Team-Building on the Fly

Teamware simplifies setting up fast-and-dirty workgroups across the Internet as well as across organizational boundaries.

By William Wong

Individuals, whether they work for a Fortune 500 company or a four-person firm, tend to do a lot of their work in ad hoc teams. And with outsourcing, telecommuting, and business partnerships, the demand for teamware—software that facilitates work flow in small and fluid workgroups—is growing.

Web-enabled enterprise work-flow products range from those that permit real-time collaboration, such as Microsoft's NetMeeting, to high-end structured work-flow development platforms, such as RadNet's WebShare and Lotus's Domino/Notes. Rather than casting work flows into programmed applications, teamware simplifies setup and security to allow team members to build, use, and tear down their work flows as needed across organizational boundaries.

Teamware augments existing user-interaction tools, such as e-mail, newsgroups, voice conferencing, and videoconferencing, while freeing network managers from the burden of setup and maintenance. It also obviates the need for network administrators to manage teams and team resources themselves, and it supports team-oriented activities, such as brainstorming, group discussions, scheduling, and polling, or voting.

Teamware also provides the coordination and data storage needed for team-oriented work. Conventional applications, such as word processors, are still used to create documents that might be stored as part of a team's resources. When a team is all done with a project and ready to move onto a new one, the old team room can be shut down.

The problem with just using e-mail is that each user must maintain a copy of all relevant information and determine who should be sent a copy. Newsgroups help alleviate this problem, but they normally require configuration by the network administrator, and they don't address other teamware actions, such as polling and scheduling. Real-time conferencing tools, such as a whiteboard, audio conferencing, and videoconferencing, typically augment teamware products, providing long-distance, real-time interaction.

BYTE BEST

TEAMWARE

Instinctive Technology's eRoom

With an interface that stands up to all comers, eRoom smoothes the way for ad hoc teamware applications—as long as you use Windows.

I reviewed five teamware servers that offer out-of-the box operation with no programming required: Changepoint's involv Intranet, Facilitate.com's Facilitate.com, Instinctive Technology's eRoom, Lotus's InstantTeamRoom, and TeamWave Software's TeamWave Workplace. Instinctive's eRoom requires Microsoft Internet Information Server (IIS) or Personal Web Server (PWS) and supports only Windows clients, while involv Intranet and InstantTeamRoom run on top of the Lotus Domino server and can handle most Web clients. Facilitate.com runs on IIS or any Web server that supports CGI/NSAPI, both on Windows and the Mac, while TeamWave Workplace is a dedicated client/server application that runs both client and server on Mac, Windows, and Unix platforms. Lotus offers InstantTeamRoom service directly, as well as through other ISPs over the Internet—billed at a flat monthly rate and requiring only a Web browser as the client.

At Your Service Provider

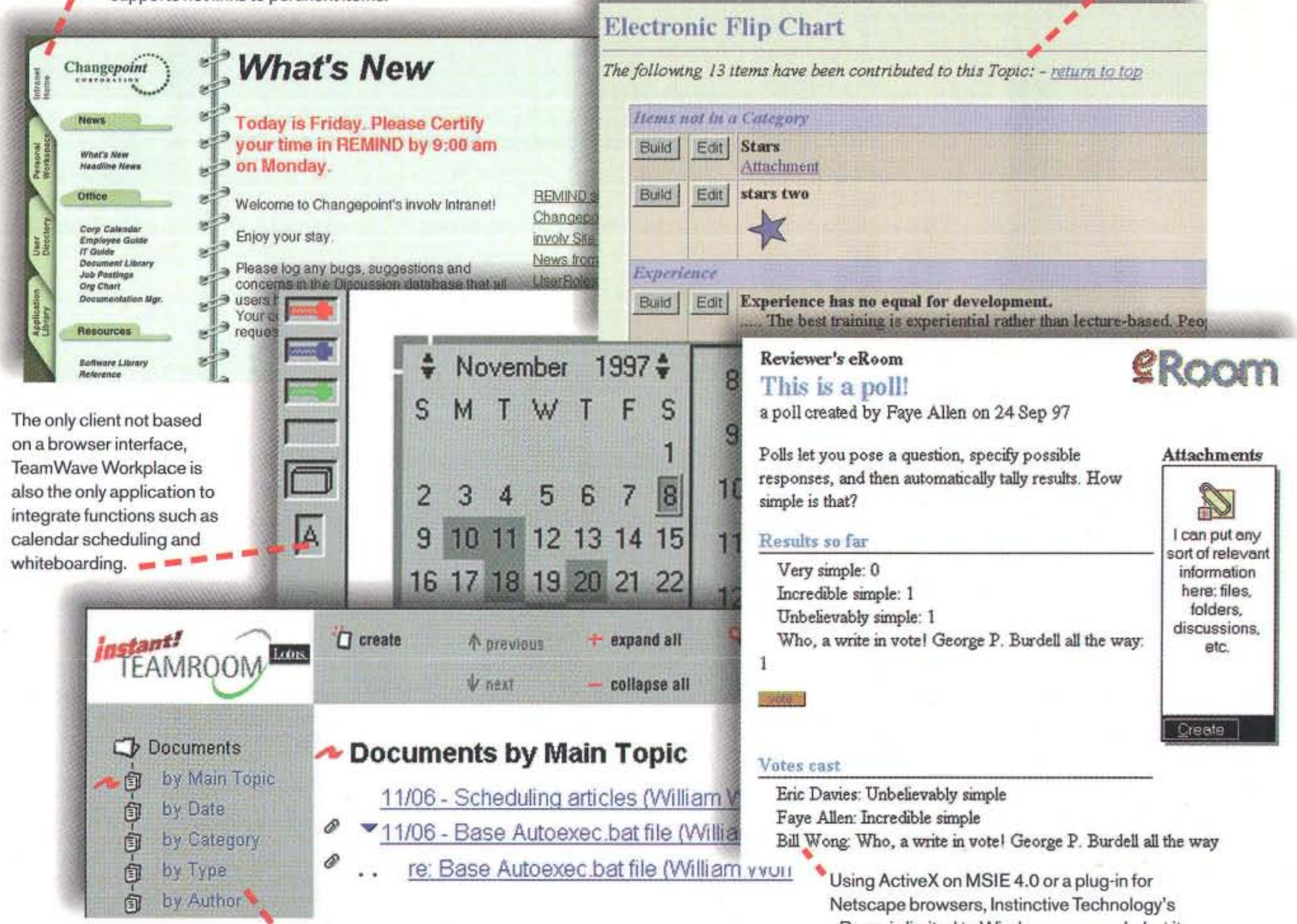
Based on TCP/IP, these teamware products work equally well over intranets or the Internet. Using teamware through an ISP makes sense for small, mobile groups, especially those whose members belong to different organizations.

A team room can be set up in 15 minutes or less. There's no additional ISP configuration needed, and participation in a team room is by invitation only. All five products are available for intranet use except for Lotus InstantTeamRoom, which is initially available only through ISPs providing InstantTeamRoom services.

Large organizations might find that hosting their own teamware server makes economic sense. These servers typically need a minimal amount of maintenance, unlike Web servers, which have regular content updates. Organizations of all sizes can benefit from an intranet teamware installation.

Facilitate.com 4.5

Facilitate.com displays all the polish of a mature product, particularly in its administration and customization tools, which were among the best of the products reviewed. You can use any Web browser that's compatible with Navigator 2.0 or higher with Facilitate.com. I tested it with both Microsoft Internet Ex-



Changepoint

What's New

Today is Friday. Please Certify your time in REMIND by 9:00 am on Monday.

Welcome to Changepoint's involv Intranet!

Enjoy your stay.

Please log any bugs, suggestions and concerns in the Discussion database that all

Electronic Flip Chart

The following 13 items have been contributed to this Topic: - return to top

Items not in a Category

Build Edit **Stars** Attachment

Build Edit **stars two**

Experience

Build Edit **Experience has no equal for development.**

..... The best training is experiential rather than lecture-based. Peo

Reviewer's eRoom

This is a poll!

a poll created by Faye Allen on 24 Sep 97

Polls let you pose a question, specify possible responses, and then automatically tally results. How simple is that?

Results so far

Very simple: 0
Incredible simple: 1
Unbelievably simple: 1
Who, a write in vote! George P. Burdell all the way: 1

Votes cast

Eric Davies: Unbelievably simple
Faye Allen: Incredible simple
Bill Wong: Who, a write in vote! George P. Burdell all the way

Attachments

I can put any sort of relevant information here: files, folders, discussions, etc.

Documents by Main Topic

11/06 - Scheduling articles (William W
11/06 - Base Autoexec.bat file (Willia
re: Base Autoexec.bat file (William Won

Changepoint's involve Intranet interface imitates a spiral-bound personal calendar with customized tabbed sections for different work functions. The Web interface supports hot links to pertinent items.

With its excellent administration and customization tools, Facilitate.com adapts the teamware concept to most Web browsers, from Netscape Navigator 2.0 and beyond.

The only client not based on a browser interface, TeamWave Workplace is also the only application to integrate functions such as calendar scheduling and whiteboarding.

Lotus InstantTeamRoom, with its hierarchical topic listings, retains the flavor of Notes, but without the headache of setting up a Domino server for ad hoc users who rent from an ISP.

Using ActiveX on MSIE 4.0 or a plug-in for Netscape browsers, Instinctive Technology's eRoom is limited to Windows users only, but it integrates teamwork functions into the desktop as well as into the browser, as illustrated by this poll of team members.

Despite the universality of the Web client, each of these Web work-flow programs uniquely adapts the browser interface for teamworking functions.

plorer (MSIE) and Netscape Navigator 4.0.

Topics (Facilitate.com's default name for team rooms) are configured by a team facilitator who has facilitator privileges. The server's administrator can limit the kinds of topics that can be created, as well as use the administrative program running on the Windows NT server to tweak options such as display fonts, and thus configure the look of Facilitate.com pages. The configuration of individual topics is handled through a browser interface.

The program lets you have three types of users: administrators, facilitators, and users. Administrators and facilitators can create topics, while everyone can access them if they have the passphrase. Each conference consists of a list of topics and subtopics that contain items, each of which can have a description as well as a URL and a file attachment. Graphical file attachments can be displayed directly within an item; a team member doesn't have to click on an icon to view a file.

Facilitate.com conferences can have different modes, depending on what function a team is doing at a given time. For example, the conference can be set to brainstorming mode to allow members to share their ideas, or to voting mode when it's time to come to a team decision. A chat mode is also available in Facilitate.com, although it can be a bit slow, and there's an option to send group broadcasts to relay messages to all team members.

Facilitate.com's lack of a scheduling option is a drawback, but it also tends to make the program easier to use and manage. Likewise, the use of conference mode-shifting might seem odd at first, but it works surprisingly smoothly.

eRoom 1.0

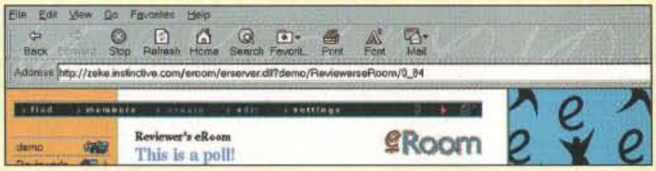
Despite its recent entry into the market, Instinctive Technology's eRoom sports one of the sharpest interfaces and some of the best features of the bunch, although its interface depends on the Microsoft ActiveX interface and requires clients to run 32-bit Windows and MSIE 3.0 or higher; users of Navigator 3.0 and higher must use

LAB RATING RESULTS

BEST OVERALL: TEAMWORK SERVER

Instinctive Technology's eRoom

eRoom's impressive interface relies on Microsoft's ActiveX technology, making it a good all-around choice for ad hoc work flows. But involv Intranet and TeamWave Workplace are both worthy competitors.


File Edit View Go Favorites Help
Back Forward Stop Refresh Home Search Favorit... Print Font Mail
Address
find
members
create
edit
settings
demo
eRoom

http://zeke.instinctive.com/eroom/erserver.dll?demo/ReviewerseRoom/0_84

Reviewer's eRoom
This is a poll!

	TECHNOLOGY	IMPLEMENTATION	FEATURES	USABILITY	OVERALL RATING
eRoom	★★★★	★★★★	★★★	★★★★★	★★★★
Facilitate.com	★★★	★★★	★★★	★★★	★★★
InstantTeamRoom	★★	★★	★★	★★★	★★
involv Intranet	★★★★	★★★★	★★★★	★★★★	★★★★
TeamWave Workplace	★★★★	★★★★	★★★★	★★★★	★★★★

★★★★★ Outstanding ★★★★ Very Good ★★★ Good ★★ Fair ★ Poor

a plug-in. An updated plug-in for the current version of Navigator wasn't ready in time for my testing, nor was support for MSIE 4.0. Likewise, the server runs only on Microsoft IIS or PWS.

Instinctive Technology's use of ActiveX might limit users to these supported platforms, but it significantly improves the user interface, adding juicy features such as the drag-and-drop addition of file attachments. Rooms in eRoom present a list of objects that have been added to a room, which can include folders, discussions, files, notes, URLs, polls, and versioned files. Folders can, in turn, contain any other objects, including more folders. Versioned files allow multiple iterations of the same document to be stored and accessed as necessary. Polls are single-question surveys with up to eight choices and an optional write-in vote. Multiple-poll objects can be in any room or folder, but chat and scheduling are not supported. The eRoom program supports e-mail notification of changes and invitations, with support for full-room or read-only participation.

The eRoom user interface will be very familiar to Windows users; the program's object-creation process uses a wizard-style approach, and the icons look like Windows icons. Of the products reviewed, I found eRoom to be the easiest to use. For a first release, it's a very polished program.

involv Intranet 2.0

Changepoint's use of Lotus Domino as the engine for involv Intranet has several implications, which will also be applicable to Lotus's own InstantTeamRoom product when it's made available to organizations. First, involv takes on important Domino features—in particular, the ability to replicate information across servers. Second, workgroup-application developers can tackle more sophisticated applications with Domino's programming environment. Likewise, involv can integrate existing Domino applications with additional programming and configuration.

Most involv installations will probably not make use of these features initially. Instead, involv's extensive features set and excellent user interface make it an impressive addition to any intranet, or even the Internet, right out of the box.

The program employs a tabbed notebook presentation, using a Web browser that supports frames. The multiframe interface makes it extremely easy to navigate, but a 1024- by 768-pixel resolution is necessary to keep the sometimes-smallish and vertically tabbed text legible.

The program provides each user with a workspace that can be populated by tools shared among users. These include tools for document management, event planning, project management, and team collaboration; available tools can be viewed and selected by category, name, or type. The program sends e-mail to notify users of group-membership changes as well as to invite them to join applications. The impressive tool set still lacks real-time interaction except for its basic chat support, but it offers the most complete scheduling support of all the products reviewed.

Domino requires some hefty processing resources, and involv only adds to that need. Luckily, Domino supports multiprocessing systems, so large involv sites are

TECH FOCUS TEAMWARE

Real-Time Teamwork

Real-time teamwork applications, such as TeamWave Workplace from TeamWave Software, provide both a persistent teamwork area and real-time interaction between team members that are on-line at the same time. This requires coordination between the TeamWave server and active TeamWave clients.

Current real-time collaboration tools, such as Microsoft's NetMeeting, use point-to-point communication among clients. All meeting participants must be available during the meeting so that the client software can record any information that's made available during the meeting. With TeamWave, the server acts as both the clearinghouse and the repository (which is available at all times). Clients do not interact directly with each other, only with the server. For example, a client clicks on a button to participate in a poll and then queries the server and responds, with the results being presented to all clients after the server processes the response. In this sense, the client/server architecture is actually split between the piece that supports the whiteboard and the piece that supports interaction initiated through the main whiteboard window, such as poll voting done through a separate dialog box.

The current version of TeamWave doesn't use a Web-browser client. But future support for a browser add-on program won't change the client/server architecture, only the workgroup application interface.

TEAMWARE FEATURES

	Changepoint involv Intranet 2.0	Facilitate.com, Inc. Facilitate.com 4.5	Instinctive Technology eRoom 1.0 ★	Lotus InstantTeam-Room 1.0	TeamWave TeamWave Workplace 2.1
PLATFORM SUPPORT					
Asynchronous operation	✔	✔	✔	✔	✔
Real-time operation	✔	✔			✔
Lotus Domino	✔	✔	✔	✔	N/A
Windows NT/IIS	✔	✔	✔		N/A
Other server platforms		Win32/Mac OS[1]	Microsoft PWS		Win, Mac, Unix
Client on MSIE 3.x	✔	✔	✔[2]		N/A
Client on MSIE 4.x	✔	✔	✔	✔	N/A
Client on Netscape Navigator 3.x	✔	✔	✔[2]	✔	N/A
Client on Netscape Navigator 4.x	✔	✔	✔[2]	✔	N/A
Other client platforms	All platforms	Navigator 2.0 and up	Windows only	Java browser	Win, Mac, Unix
SERVICES					
Billing	✔			✔	
Web client	✔	✔	✔	✔	
Drag-and-drop file manipulation			✔		
E-mail invitation	✔		✔	✔	
E-mail change notification	✔		✔		
Application development	✔[3]		✔[4]	✔[3]	✔[5]
File attachments	✔	✔	✔	✔	✔
Displayable graphics attachments	✔			✔	
Embedded URLs	✔	✔	✔	✔	✔
File versioning	✔	✔	✔	✔	✔
Object-level security	✔		✔	✔	
Remote management	✔	✔	✔	✔	✔
Browser-management interface	✔	✔	✔	✔	
TOOLS					
Brainstorming	✔	✔	✔	✔	✔
Bulletin board	✔	✔	✔	✔	✔
Scheduling	✔				✔
Discussion	✔	✔	✔	✔	✔
Database	✔				✔
Voting	✔	✔	✔	✔	✔
Chat	✔	✔			✔
Whiteboard					✔

★ = BYTE Best

✔ = yes; N/A = not applicable.

[1] Supports Win32/Mac OS servers with CGI/NSAPI support.
[2] Support for IE 4.x and Navigator 4.x will be available by press time.
[3] Application development through Lotus Domino.
[4] Undocumented API.
[5] Scripting is possible with the Tcl scripting language.

possible. Although Lotus has lowered the high cost of investing in Domino, the expense of setting up Domino plus involv on a high-end system might be more than some organizations can justify—particularly if they already have a significant investment in other intranet infrastructure products based on Windows or Unix. A Domino server will operate in a mixed environment, but Domino-based applications may not interoperate well—if at all—with other legacy systems.

At $5000 per server and as much as $90 per user, involv Intranet can get pricey, but it's still a hands-down, no-brainer choice for Domino installations with deep pockets. Others should consider it but also check out alternatives if Microsoft IIS or budget constraints are a part of the puzzle.

InstantTeamRoom 1.0

Lotus designed InstantTeamRoom as a service that ISPs could deliver as a value-added service to their customers, but the company might make an intranet version available to organizations as early as this year. The service is now available from ISPs Interliant, Netcom, and U.S. West, and it's also available directly from Lotus. The going rate is $14.95 per user, per month, with no limitations on the number of conferences created or the amount of storage used for file attachments. All you need to get started is a credit card and a browser that supports Java (Navigator 3.0 or higher or MSIE 4.0 or higher, on any platform).

Once you're set up, you can start creating TeamRooms simply by inviting participants, although the Room's creator pays for all invitees to the Room, whether they participate or not. Included with the package but hidden from users are support for customer tracking and billing. Invitations are easy to make as long as you've got all the invitees' e-mail addresses. InstantTeamRoom generates and sends each participant (and only those participants) a message with a log-on name and password.

Like involv Intranet, InstantTeamRoom runs on top of Domino. It provides basic discussion, brainstorming, and file-sharing support, but it lacks involv's sophistication and the real-time support found in TeamWave Workplace. On the plus side, the product's limited functionality simplifies the user interface. Unlike the other products reviewed, InstantTeamRoom links anyone with a browser and e-mail from anywhere; it's an ideal extranet solution for small workgroups spanning different organizations.

If you and your workgroup can access the Internet, then you can get up and running on InstantTeamRoom with a minimal investment of time and money. Expect ISPs to jump on the teamware bandwagon once users see how easy InstantTeamRoom can be to set up and use.

TeamWave Workplace 2.1

TeamWave Software's TeamWave Workplace server/client software runs on a variety of platforms, including Windows 95 and NT, the Mac, and assorted Unix flavors. For now, TeamWave Workplace is strictly TCP/IP client/server, meaning it works over the Internet or any intranet; Web-client support, via a plug-in, and integrated MAPI e-mail support are planned for sometime in the future.

Price is key to TeamWave's success. At $50 per user—comparable to about three months of Lotus InstantTeamRoom—TeamWave includes asynchronous interaction with bulletin boards and brainstorming, as well as live interaction with chat and support for whiteboarding. Like eRoom, TeamWave allows any number of objects to be created and placed in a workgroup room. One deficiency is that objects cannot be viewed in a list mode, nor can you search for them. On the other hand, the graphical display of objects on the whiteboard allows users to see multiple objects at one time. You can add annotations directly to the whiteboard, and there are even sticky-note objects.

Test Methodology

Each product was set up on a 166-MHz Pentium system with 32 MB of RAM and plenty of hard disk space running Windows NT Server 4.0. TeamWave Software's TeamWave Workplace was also tested on a 200-MHz Pentium II PC running Windows 95. The NT Server 4.0 machine also ran Microsoft Internet Information Server (MSIE) and Lotus Domino Server—although not at the same time, since both provide Web-server support.

Client PCs ran Windows 95 with Internet Explorer 3.02 and 4.0, as well as Netscape Navigator 3.x and 4.x. Instinctive Technology's eRoom needed Navigator 3.x and Internet Explorer 3.02. The TeamWave Workplace client is a stand-alone application.

Testing of each product began with user creation and notification. Most of the products provide these features in one step. I then created multiple work areas for fictitious groups. One group was responsible for software development, with multiple versions of multiple application files to track. The same group area was made available to beta users in a read-only form. I also set up a marketing group with multiple brainstorming and discussion sections. The brainstorming sessions included at least one vote or poll with multiple questions, and I used meeting scheduling, where available, for all areas where it was needed.

PRODUCT INFORMATION

eRoom 1.0
$645 for a five-user starter kit
(Microsoft IIS or PWS)
Instinctive Technology, Inc.
Cambridge, MA
617-497-6300
http://www.instinctive.com
Enter HotBYTEs No. 1029.

Facilitate.com 4.5
$5995
(CGI/NSAPI Web server or Microsoft IIS)
Facilitate.com, Inc.
San Francisco, CA
800-423-8890
http://www.facilitate.com
Enter HotBYTEs No. 1028.

InstantTeamRoom 1.0
$14.95/user/month
(Lotus Domino)
Lotus Corp.
Cambridge, MA
617-577-8500
http://www.lotus.com
Enter HotBYTEs No. 1030.

involv Intranet 2.0
$5000/server; $90/user
(Lotus Domino)
Changepoint International Corp.
Richmond Hill, Ontario, Canada
905-886-7000
http://www.changepoint.com
Enter HotBYTEs No. 1027.

TeamWave Workplace 2.1
$50 per user
(Win32/Mac OS/Unix)
TeamWave Software, Ltd.
Calgary, Alberta, Canada
fax: 403-282-1238
http://www.teamwave.com
Enter HotBYTEs No. 1031.

at http:/www.byte.com/hotbytes/

TeamWave's object list is extensive, with everything from calendars to discussion groups supported. Polling objects handle only a single question at a time, but multiple polling objects can be created. A chat window is standard and sits at the bottom of the screen so users can dispense with telephone contact but still interact with each other in real time. Application developers can even customize TeamWave with the Tcl scripting language.

One major drawback hobbles TeamWave: an out-of-date client interface. It uses Unix Motif–style windows management: You move windows by dragging on their edges, and you resize them by dragging on corners. TeamWave objects are functional but limited. For example, the database object allows you to add any number of fields, but it has only rudimentary forms support.

Balancing out these significant drawbacks, however, are some nice features. For instance, the program lets you know in real time who else is visiting a room. It also offers TeamWave URL and door objects, which allow users to move quickly to Web pages or other TeamWave rooms by double-clicking on the object.

TeamWave is a reasonable option for small workgroups looking for a single teamware solution, as long as they don't mind adding yet another client to their desktop. TeamWave could use a good bit of polish, but it's a diamond in the rough that's worth checking out.

Joining the Teamware

Each reviewed product fits into a distinctive group, which may make your purchasing selection a bit easier. For instance, InstantTeamRoom is currently the only choice for hosted Internet support. Installations already using Domino are likely to choose Changepoint's involv Intranet or Lotus's InstantTeamRoom. Likewise, people using Windows NT Server with IIS might gravitate to Facilitate.com or Instinctive Technology's eRoom.

Meanwhile, TeamWave Software's TeamWave Workplace is the only product that provides full real-time whiteboard support as part of the basic package. TeamWave's lack of Windows NT service support might present a security issue, but it's still a workable solution.

Finally, firewall issues might eliminate some products. For organizations that strictly use a Web server via HTTP, InstantTeamRoom and involv Intranet will work best. Organizations interested in providing fee-based teamware services should check out involv Intranet, InstantTeamRoom, Facilitate.com, and eRoom. B

William Wong is a computer consultant and author based in Yardley, Pennsylvania. You can contact him at **bwong@voicenet.com**.

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Southwestern College Publishing- Textbooks and Technology

Key Bank
Cyberspace Changes Banking

Means Telecom
Building The Information Superhighway

Home Automated Living
Better Living Through Computers

Sapiens
Fewer Than 800 Days Until The Deadline

Universal Tax Systems
Prepare and File Your Taxes On-line

BMW - Innovations in Automotive Safety

Commentary From BYTE Editor In Chief, Mark Schlack

MEANS TELCOM

iomega

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An International Thomson Publishing Company

KISS

MYSTIC COLOR LAB

BMW

EDUCATIONAL INSTITUTE

HAL2000
Home Automated Living's™ system of the Future

SECURETAX™

SAPIENS

UofL

Storage: Part 1

15 Disks Cover More Data Than Ever

The newest hard drives are high-speed, high-capacity marvels: better, cheaper, and able to pack more data into ever-smaller volumes.

By Russell Kay

Seven years ago, I bought a hard disk I thought would be big enough to last me for years to come: It was a 5¼-inch SCSI monster that held 80 MB. So much for predictions. Four years ago, a 500-MB drive was considered pretty big. Today, it's tough to even buy a new desktop computer from a discount store with less than a 3-GB hard drive. The growth of storage in our computers has outpaced even Moore's Law.

With that in mind, BYTE looks at what's available in disk drives today, and we've found that it's an impressive lot. We've organized our disk report into categories by capacity and intended use. First, 4- to 7-GB drives, intended mainly for desktop workstations; second, 8- to 11-GB drives, intended mainly for server use, though applicable to higher-end workstations as well; and third, SCSI drives holding more than 11 GB, for servers and audiovisual applications.

We asked each of the major disk vendors to submit up to two drives in each of our three categories. We received test units from Fujitsu, IBM, Maxtor, Quantum, Seagate, and Western Digital. At test time, Hitachi and Samsung said they had no appropriate models available. And Micropolis, which had shown some interesting new disk drives, was abruptly and inconveniently put out of business by its Singapore parent company.

This last event brings up an interesting point: the shrinking community of disk drive producers. According to data from Western Digital, in 1985 there were nearly 60 disk drive manufacturers in the market. Today, only about a dozen makers account for virtually all the drives sold. Ironically, even though the number of hard disk vendors has decreased, hard disk storage continues to be a thriving business. The American Stock Exchange announced last fall the addition of a new equity index (DDX) composed of companies that manufacture computer disk drives of all form factors and capacities, as well as related components.

The unrestrained growth in disk storage should raise a warning flag when it comes to backup. With disks so large, your backup system has to be equally capacious. In "The Changing Face of Backup" (page 116), we take a look at the growing array of backup options: removable media, tape and disk, magnetic and optical. Solid-state's much too expensive for backup.

BYTE BEST

HARD DRIVES

Maxtor DiamondMax 1280
Maxtor offers top-notch performance at a bargain-basement price with its DiamondMax 1280.

Maxtor DiamondMax 2160
No slouch in the MPC benchmark tests, the low-cost Maxtor DiamondMax 2160 is built for speed.

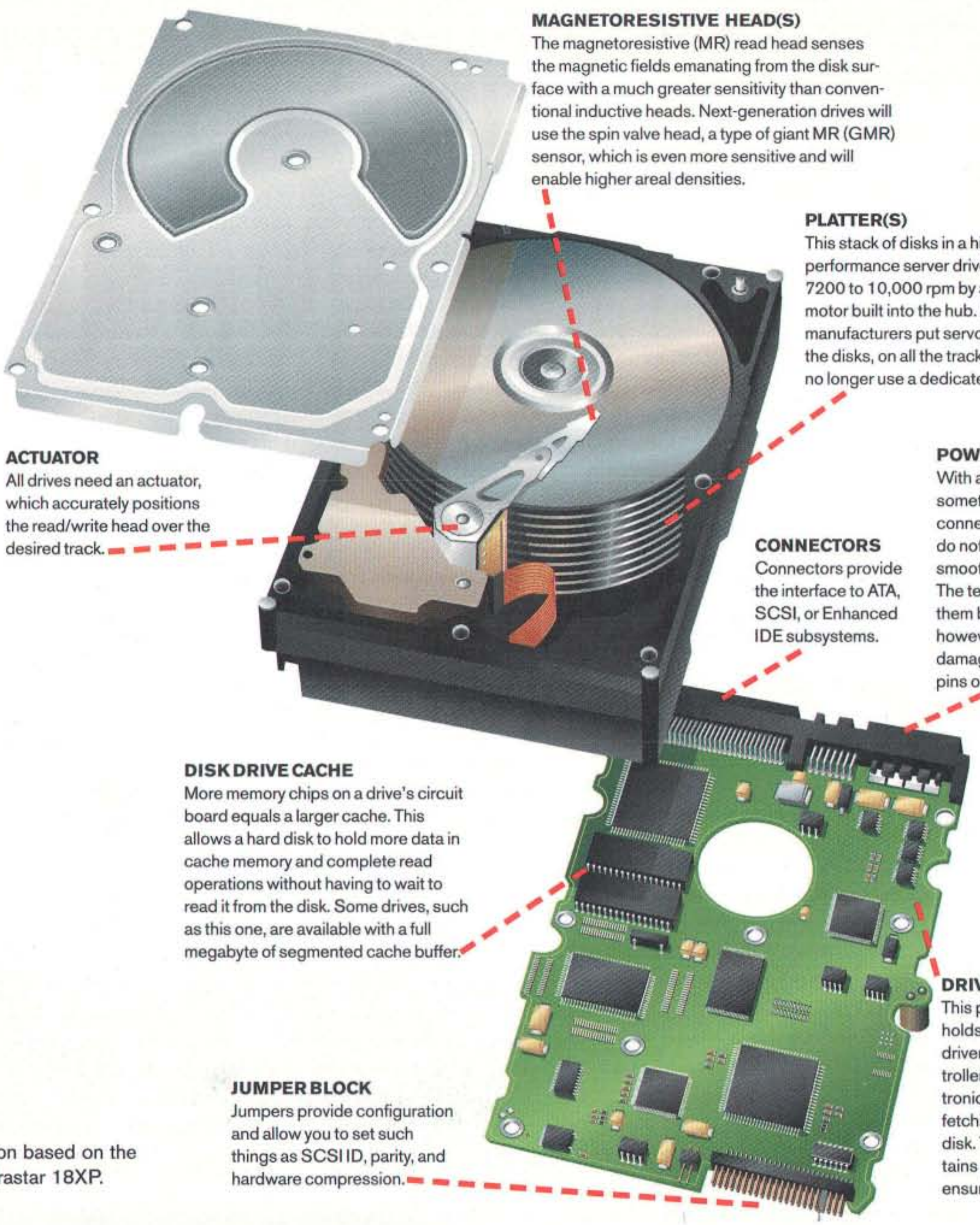
IBM Ultrastar 18XP
A solid high-capacity server drive, IBM's Ultrastar 18XP transfers data fast.

For our tests, vendors submitted the highest number of drives in the middle-size, server-class category, where 9 GB is the apparent sweet spot, the size that most network administrators will be most interested in. Large capacity plus a small form factor (the standard is now 3½-inch drives just 1 inch high) combine for cost-efficient RAID arrays. Also, this amount of storage seems to represent the threshold at which a service technician can manually replace a drive and restore or reinstall its applications in a single day. Plus, you can plug in these models as direct replacements for your currently installed 4.5-GB drives.

In comparing disk drives as disparate as this current group, we considered that drive capacity would, to some extent, be an indicator of typical use. The smaller drives are more likely to be used in workstations and desktop applications, while bigger, faster drives, especially those with a SCSI connection, are prime candidates for use in servers. And then there are the two biggest drives—IBM's 18-GB Ultrastar and Seagate's 23-GB Elite—which are likely to find use in large server installations and in video production.

When it comes to disk drives, BYTE considers three factors: performance, reliability, and price. To evaluate this new crop of drives, we tested performance by measuring data throughput. Some vendors have made a lot of noise about designs with faster access times, higher rotation speeds, improved resistance to vibration and shock, and bigger on-disk caches. But, for practical purposes, all those parameters can be subsumed in one test by measuring throughput.

To test throughput, we installed each drive in a Dell Optiplex GXpro 200 with 64 MB of RAM. The IDE and ATA drives were connected to the on-board



MAGNETORESISTIVE HEAD(S)
The magnetoresistive (MR) read head senses the magnetic fields emanating from the disk surface with a much greater sensitivity than conventional inductive heads. Next-generation drives will use the spin valve head, a type of giant MR (GMR) sensor, which is even more sensitive and will enable higher areal densities.

PLATTER(S)
This stack of disks in a high-performance server drive is spun at 7200 to 10,000 rpm by a spindle motor built into the hub. Most manufacturers put servo data all over the disks, on all the tracks, and no longer use a dedicated servo.

ACTUATOR
All drives need an actuator, which accurately positions the read/write head over the desired track.

POWER CONNECTOR
With a brand new drive, sometimes the power connector and the interface do not slide together as smoothly as you would like. The temptation is to rock them back and forth; however, this can cause damage to the connector pins or housing.

CONNECTORS
Connectors provide the interface to ATA, SCSI, or Enhanced IDE subsystems.

DISK DRIVE CACHE
More memory chips on a drive's circuit board equals a larger cache. This allows a hard disk to hold more data in cache memory and complete read operations without having to wait to read it from the disk. Some drives, such as this one, are available with a full megabyte of segmented cache buffer.

DRIVE ELECTRONICS
This printed circuit board holds the actuator, motor drivers, disk drive controller, and interface electronics for storing and fetching information on the disk. The PCB also contains protective sensors to ensure reliability.

JUMPER BLOCK
Jumpers provide configuration and allow you to set such things as SCSI ID, parity, and hardware compression.

Illustration based on the IBM Ultrastar 18XP.

ILLUSTRATION: SANDERS/TIKKANEN DESIGN & ILLUSTRATION © 1998

Enhanced IDE (EIDE) controller, and the SCSI drives were connected to an Adaptec AHA 2940W/2940UW SCSI controller.

We feel that many specific design choices really don't matter in the end to most users, provided the drive delivers data as quickly as it's called for. Similarly, problems associated with vibration (as might be encountered in a server's large array of drives, for example) show up mainly as thermal asperities and, ultimately, in reduced throughput. The table on pages 118-119 details the specs for each drive.

Ultimately, we recognize that the drives we tested—big as they are now—will be considered midgets in a few years as newer and nonmagnetic technologies enter the market. Even with magnetic disk drives, as Ed DeJesus explains in "Infinite Space" (page 121), manufacturers are achieving ever-greater storage densities by using magnetoresistive (MR) and MR-extended (MR-X) heads in place of the older, thin-film technology. Western Digital was the last major disk drive manufacturer to adopt the newer head design. Now IBM, which invented MR and MR-X technology, has announced a giant MR (GMR) head that permits record/playback densities of 10 times what we're seeing in early 1998. The company has already announced the first GMR drive, one that packs more than 16 GB into a 1-inch-high form (and one we plan to review in an upcoming issue).

So look over our test results and product specs, then buy whatever disk drives you need right now. But you should realize that the picture is likely to be radically different in another year.

Contributors

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BEST OVERALL HIGH-CAPACITY DISK DRIVES

In the desktop group, holding 4 to 7 gigabytes, mostly EIDE or ATA drives, there's a big difference in what's available. Prices cover almost a 3:1 ratio. The Maxtor DiamondMax 1280, the least expensive drive in this report, got top marks in performance. Curiously, its brandmate, the DiamondMax 1750, was one of the poorest performers in our tests. The smallest drive we reviewed, the IBM Ultrastar 9ES, was the most expensive unit in this group, which helped move it toward the bottom of the ratings.

In the midsize, server-oriented group (8 to 11 GB), we found an even bigger price spread. The Maxtor DiamondMax 2160 took top honors because of its price and good showing on the MPC benchmarks. It didn't perform nearly as well on the ThreadMark test, however, so it might not be your best choice for a server application. Here, the Seagate Medalist Pro, an ATA drive, is an excellent choice. In our tests, it significantly outperformed its speed-racer brother, the 10,000-rpm Seagate Cheetah 9, which also costs twice as much.

The two IBM drives in this group are quite different from each other. The Deskstar 8 is really designed to be a workstation drive, even though its 8.4-GB capacity puts it in with the server drives in our tests. The Ultrastar 9ZX, a relatively new drive from IBM, uses MR-X (magnetoresistive-extended) heads and a SCSI connector. This Ultrastar and the Seagate Medalist Pro got the highest ThreadMark scores, by a significant margin, of all the drives we tested.

The two models in our behemoth group (18+ gigabytes) are as different as they can be. The IBM Ultrastar 18XP is brand new and uses MR-X heads for high-density recording. The Seagate Elite 23 is the only 5¼-inch drive in our report, so its larger capacity isn't as much of an accomplishment as it might first seem. (But see "Details" on page 116 before dismissing Seagate.) For an overview of how all the tested drives performed, see the performance chart (page 117) showing both the MPC benchmark results and the ThreadMark scores.

TECH FOCUS DRIVE ARCHITECTURE

Bearing the Load

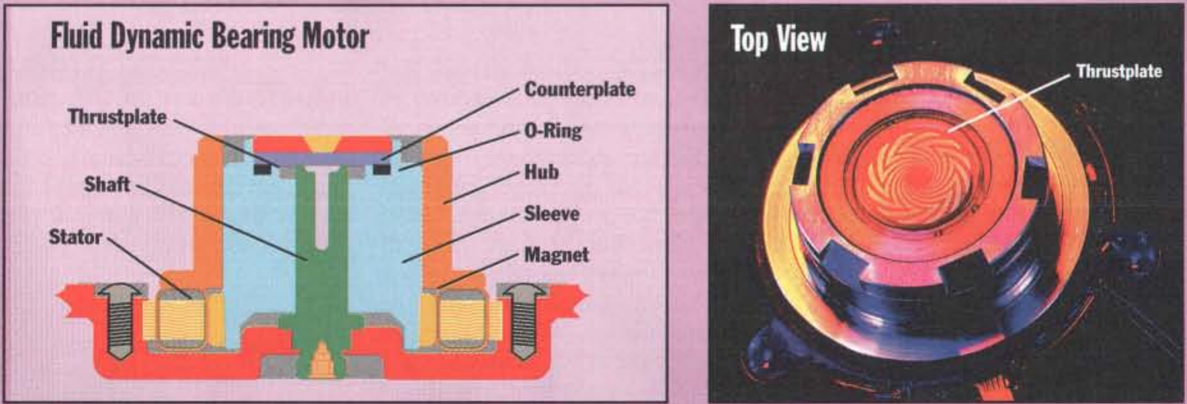
Last fall Seagate released its 7200-rpm, 9.1-GB Medalist Pro 9140, which features a fluid dynamic bearing motor. In December, the company unveiled a high-performance drive with this type of motor, 12 platters, and 45-GB capacity. Expect to see this technology in 2½-inch drives soon, Seagate says.

Seagate admits the technology is not new; it has been used in gyroscopes and high-accuracy machine tools for 50 years or more. However, when applied to disks, it brings a new level of mechanical damping into the drives, helps make the drives more stable, and improves their ability to read and write tracks. In a nutshell, using fluid dynamic bearing motors results in drives that are quieter, use less power, and perform better than existing drives with ball-bearing motors.

Other advantages include relative high damping, compared to ball bearings, which allows the disk to read and write at very high speeds with virtually no vibration over the tracks. This kind of drive can also read and write very accurately on a higher number of tracks per inch. Additionally, noise is lowered by fluid dynamic bearing motor technology. Without ball bearings there's no metal-to-metal contact.

Serious advances with these motors will continue within the next 9 to 24 months, according to Gunter Heine, vice president of Seagate's Motor Group. This is because Seagate (along with its three strategic supply and manufacturing partners) has a relative lock on how the drive components are made. Though fluid dynamic bearing motors offer significant advances in shock and acoustics, vibration, and fatigue life (number of hours before metal fatigue sets in and causes bearings to fail), Seagate has managed to keep the cost down to around the same as ball-bearing motors. It's just a matter of time before competing companies catch up.

– Michelle Campanale



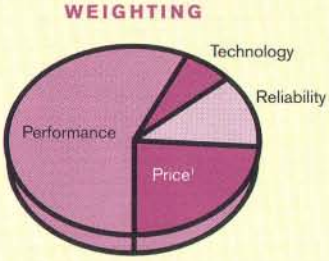
In hard drives that use fluid dynamic bearing motors (like some Seagate models), the piece parts inside the motor form air gaps that are filled with viscous oil; this oil can withstand temperature changes far greater than what traditional ball-bearing drives can withstand.

LAB RATING RESULTS

BEST OVERALL: DESKTOP DRIVES (4–7 GB)

Maxtor DiamondMax 1280

The top performer at a very good price, the DiamondMax 1280 easily won this category. Its fast ATA-4 interface allows it to pop right into most desktop systems.

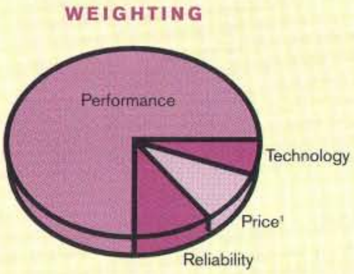

WEIGHTING

	CAPACITY (GB)	INTERFACE	PRICE	TECHNOLOGY	PERFORMANCE	RELIABILITY	VALUE	OVERALL RATING
Maxtor DiamondMax 1280	**5.1**	**ATA-4**	**$309**	★★★	★★★★★	★★★★	★★★★	★★★★★
IBM Deskstar 8	6.4	ATA-3	$319	★★★	★★★★	★★★	★★★★	★★★★
Fujitsu Desktop Series MPB3064AT	6.5	ATA-3	$429	★★★	★★★★	★★★★	★★★	★★★★
Western Digital Caviar 3640	6.4	EIDE	$380	★★★	★★★★	★★★	★★★	★★★
Maxtor DiamondMax 1750	7.0	ATA-4	$379	★★★	★★★	★★★★	★★★★	★★★
IBM Ultrastar 9ES	4.5	SCSI-3	$719	★★★★	★★★★	★★★	★	★★★

BEST OVERALL: SERVER-CLASS DRIVES (8–11 GB)

Maxtor DiamondMax 2160

This DiamondMax took top honors in the MPC benchmark, but it didn't fare as well with ThreadMarks. So, it's a good candidate for higher-end workstations. For server use, consider Seagate's Medalist Pro 9140.

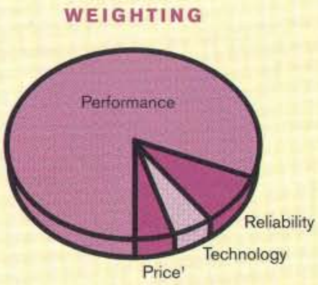

WEIGHTING

	CAPACITY (GB)	INTERFACE	PRICE	TECHNOLOGY	PERFORMANCE	RELIABILITY	VALUE	OVERALL RATING
Maxtor DiamondMax 2160	**8.4**	**ATA-4**	**$459**	★★★	★★★★★	★★★★	★★★★★	★★★★★
Seagate Medalist Pro 9140	9.1	Ultra ATA	$495	★★★★	★★★★★	★★★	★★★★	★★★★★
IBM Deskstar 8	8.4	ATA-3	$399	★★★	★★★★★	★★★	★★★★	★★★★
IBM Ultrastar 9ZX	9.1	SCSI-3	$1245	★★★★	★★★★★	★★★	★★	★★★★
Quantum Fireball SE	8.4	Ultra ATA	$450	★★★	★★★★	★★★	★★★★	★★★★
Seagate Cheetah 9	9.0	Ultra Wide SCSI	$1099	★★★★★	★★★	★★★★★	★★	★★★★
Western Digital Enterprise WDE9100	9.1	Ultra SCSI	$900	★★★★	★★★	★★★★★	★★	★★★

BEST OVERALL: HIGH-CAPACITY SERVER DRIVES (18+ GB)

IBM Ultrastar 18XP

IBM's Ultrastar 18XP delivers a lot of data, and does it significantly faster than Seagate's Elite 23, which is also physically larger.


WEIGHTING

	CAPACITY (GB)	INTERFACE	PRICE	TECHNOLOGY	PERFORMANCE	RELIABILITY	VALUE	OVERALL RATING
IBM Ultrastar 18XP	**18.2**	**SCSI-3**	**$1745**	★★★★	★★★★	★★★	★★	★★★★
Seagate Elite 23	23	Ultra Wide SCSI	$1890	★★★	★★	★★★	★★	★★

★★★★★ Outstanding ★★★★ Very Good ★★★ Good ★★ Fair ★ Poor

[1] = Cost per GB

PHOTOGRAPH: STEVEN GREENBERG © 1998

Big and Small in One

Western Digital's Enterprise WDE9100 is the biggest small drive in our tests—small in physical terms, that is. In the popular 3½-inch, 1-inch-high form factor, this drive will be a convenient plug-in replacement to double the capacity of the 4.5-GB drives used in many server applications and RAID arrays.

The Big Guys Get Bigger

Seagate's Elite 23 has the largest capacity of all the drives we tested, but technology marches on. Seagate has now announced a 47-GB big brother in the Elite series. There's a down side to such high capacity, of course: When a bigger drive goes down, you lose a lot more data. So, we expect to see these drives used primarily in RAID applications.

The Changing Face of Backup

As disk drives get larger and larger, answers to the questions of how to back up the data on them, and how to access that backed-up data when you need it, become more complex. Consequently, each backup option serves a different purpose and exacts a different price. There really isn't a simple solution. In some situations, you actually need to use a combination of backup schemes. The information that follows summarizes your choices.

Tape Cartridges

The most traditional backup medium, magnetic tape is still important in a lot of situations. Tape-drive makers have tried to keep pace with the expanding disk capacities of our computers, and the latest inexpensive tape backup units, such as Hewlett-Packard's Colorado 5 GB and Iomega's DittoMax and DittoMax Pro, are eminently affordable. With per-cartridge capacities between 3 and 10 GB, media costs in the $25 to $40 range, and drives selling for $200 to $300, tape is a quick, readily available alternative that's well suited to individual users and small servers. More expensive, server-oriented tape backup units can store 20 to 40 GB per cartridge, with greater reliability and concomitant greater cost.

Optical Disks

Optical disk backup has a lot going for it: permanence, random-access restores, and inexpensive media. But the need for streaming, uninterrupted input to the recorder makes it still more painful to write a CD-R than to do a tape backup. And, the capacity of a single disk is still limited compared to that of a tape cartridge. When digital versatile—née video—disc (DVD) becomes more mainstream, and recordable DVD (whether DVD-R or any of the rewritable formats) becomes standardized, that medium's greater capacity per disk will make DVD far more competitive with tape.

Library or Jukebox Systems

These aren't generally intended for backup as much as for reasonably quick access to databases (we're no longer talking gigabytes here, but terabytes and, down the road, petabytes). Because they are mechanically complex, with multiple drives and robotic media handling, library systems are not cheap, and they require attention to maintenance and usage. But they sure are faster and cheaper than having armies of people run around and mount tapes upon user request.

Backup Hard Disks

For the simplest of systems, one effective backup choice is to buy an additional hard disk and devote it to storing copies of data or programs. This can be very useful if you don't have to keep a long-term history of what's been done but merely need a backup copy in the event the original hard drive fails. Of course, like any on-site backup system, it won't be a lot of help if the building catches fire.

Removable Media

There's an ever-increasing crop of removable storage products that can also be highly useful and effective as backup. In the 40- to 250-MB category, the most familiar is Iomega's 3½-inch 100-MB Zip disk. SyQuest and Imation have like-capacity products. Additionally, Sony and Fuji Film have just announced a new format called HiFD: a 200-MB floppy disk technology that is backward-compatible with standard floppies. The 1- to 2-GB arena includes products such as Iomega's Jaz Drive, various products from SyQuest, and Castlewood Systems' ORB drive, a new optical disk system that uses 3½-inch removable media with a capacity of 2.16 GB and, the company says, an impressive transfer rate of 12.2 megabytes per second.

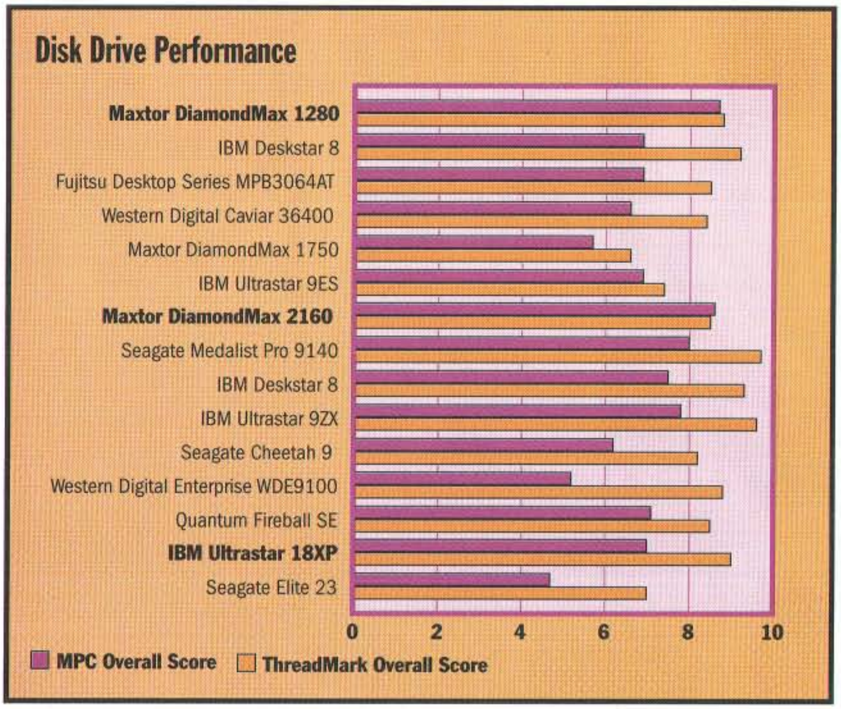
TEST METHODOLOGY

We measured throughput with two different tests. The MPC benchmark, which NSTL developed for the Multimedia PC Council in conjunction with Intel, measures data throughput for both random and sequential access. It determines how much CPU power disks need, and indicates what impact they will have on the delivery of multimedia content.

A second test, which uses the ThreadMark benchmark software from Adaptec (available at http://www.adaptec.com), is designed to indicate how well a disk subsystem handles periods of high I/O activity. We deem this test important because you're likely to find server applications where the drive handles a large number of requests from many different users. ThreadMark makes a series of measurements using a mixture of single and multithreaded requests across a range of request block sizes (2 KB to 64 KB).

Both the ThreadMark and the MPC benchmarks comprise our performance score, which equals from 65 to 80 percent of a drive's overall rating. Cost-per-gigabyte is another 5 to 20 percent of the overall score. Reliability, which is difficult to test, makes up the remaining 10 to 15 percent of the overall score. (See the charts on page 115.) We rated these hard drives by warranty length and by mean time between failures, or MTBF. (For the IBM drives, we assumed an average MTBF figure; see the features table.) MTBF, measured in hours, is a calculated statistical attribute, determined by combining the MTBF numbers for all the components that make up the unit. A problem with relying on MTBF is that you can test it only with large numbers of identical samples. And even though storage densities are increasing, track widths are decreasing, making alignment, precision manufacturing, and head-motion control more critical than ever. Today's high-capacity drives are more reliable than ever thought possible, with 1 million hours MTBF being a common figure. Note that this is not the same thing as saying that a given drive will run without failing for 1 million hours; this figure actually translates to about a 99.999 percent uptime rate over one calendar year.

Disk Drive Performance



Backup Alternatives

	Magnetic Tape Cartridge	Library/ Jukebox System	Separate Disk Drive	Write-Once Optical Media
Media format	QIC, Travan, DAT, 8mm	Tape or optical disk		CD-R, WORM, DVD-R
Capacity per media unit	★★★★	★★★★	★★	★★
Media cost per GB	★★★★★	★★★★★	★	★★★★
Equipment cost per GB	★★★★	★	★★★★	★★★
Relative time to access stored data	★	★★★	★★★★★	★★★
Relative time to back up data	★	★★	★★★★★	★★★
Maintenance required for equipment	★★	★	★★★★★	★★★
Maintenance required for media	★	★	★★★★★	★★★★★
Permanence of stored data	★	★ (tape) ★★★★★(optical)	★★★	★★★★★
Typical usage scenario	Daily backup of individual workstations or network segments	Providing quick, but not instant, access to large volumes (terabytes) of data	Immediate data availability and system uptime are mission-critical	Long-term, archival storage; preservation of version histories

★★★★★ Outstanding ★★★★ Very Good ★★★ Good ★★ Fair ★ Poor

HIGH-CAPACITY DISK DRIVES FEATURES

	Fujitsu Computer Products of America Desktop Series MPB3064AT	**IBM Storage System Div. Deskstar 8**	**IBM Storage System Div. Deskstar 8**	**IBM Storage System Div. Ultrastar 9ES**	**IBM Storage System Div. Ultrastar 9ZX**	**IBM Storage System Div. Ultrastar 18XP** ★
Price as tested (MSRP)	$429	$319	$399	$719	$1245	$1745
Overall rating	★★★★	★★★★	★★★★	★★★	★★★★	★★★★
Formatted capacity (GB)	6.48	6.4	8.4	4.5	9.1	18.2
Number of platters (disks)	3	3	4	3	6	10
Number of heads	6	6	8	5	12	20
Interface (controller)	ATA-3	ATA-3	ATA-3	SCSI-3	SCSI-3	SCSI-3
Average seek time (ms)	<10	9.5	9.5	7.5	6.3	7.5
Track-to-track seek (ms)	2.5	2.2	2.2	0.8	0.7	0.7
Full-track read (ms)	19	15.5	15.5	15	17	17
Rotation speed (rpm)	5400	5400	5400	7200	10,020	7200
Buffer size (KB unless noted)	256	512	512	512	1 MB	1 MB
Transfer rate to host (MBps)	Burst DMA Mode 2 & Mode 4, 16.7 MBps; Ultra DMA Mode, 33.3 MBps	Up to 33.3	Up to 33.3	Up to 40	Up to 40	Up to 40
MTBF	500,000	800,000*	800,000*	1,000,000*	1,000,000*	1,000,000*
Form factor	3.5	3.5	3.5	3.5	3.5	3.5

POWER USAGE

Read/write (watts)	5	6.6	6.6	9.9	18.8	15.4
Idle (watts)	4.5	4.7	4.7	5.3	16.4	13.1
Sleep (watts)	0.6	N/A	N/A	N/A	N/A	N/A

CUSTOMER SUPPORT

Warranty (years)	3	3	3	5	5	5
Toll-free phone number	800-626-4686	800-426-2968	800-426-2968	800-426-7777	800-426-7777	800-426-7777
Phone	408-432-6333	See Web site	See Web site	See Web site	See Web site	See Web site
On-line address	http://www.fepa.com	http://www.ibm .com/storage	http://www.ibm .com/storage	http://www.ibm .com/storage	http://www.ibm .com/storage	http://www.ibm .com/storage
HotBYTEs No.	**1064**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**

★ = BYTE Best

✔ = yes
N/A = not available

★★★★★ Outstanding
★★ Fair

★★★★ Very Good
★ Poor

★★★ Good

Maxtor Corp. DiamondMax 1280	Maxtor Corp. DiamondMax 1750	Maxtor Corp. DiamondMax 2160	Quantum Corp. Fireball SE 9140	Seagate Technology Cheetah 9	Seagate Technology Elite 23	Seagate Technology Medalist Pro	Western Digital WD Caviar 36400	Western Digital Enterprise WDE9100
$309	$379	$459	$450	$1099	$1890	$495	$380	$900
★★★★★	★★★	★★★★★	★★★★	★★★★	★★	★★★★★	★★★	★★★
5.1	7	8.4	8.4	9.1	23.2	9.1	6.4	9.1
4	4	4	4	8	14	4	3	6
8	8	8	8	16	28	8	6	12
ATA-4	ATA-4	ATA-4	Ultra ATA	Ultra Wide SCSI	Ultra Wide SCSI	Ultra ATA	EIDE	Ultra SCSI
9.7	<10	9.7	9.5	8	13	9.5	9.5	7.9
1	1.2	1	2	0.78	1.1	2	2	0.8
21	18	18	20	18	28	21	19	17
5400	5200	5200	5400	10,033	5400	7200	5400	7200
256	256	256	128	512	2 MB	512	256	512
PIO Mode 4, 16.6 MBps; Mode2 Ultra DMA, 33.3 MBps	Up to 33	Up to 33	PIO Mode 4, 16.7 MBps; PIO Mode 3, 11.1 MBps	Up to 40	Up to 40	Up to 33.3	PIO Mode 4, 16.6 MBps; DMA/33, 33.3 MBps	Up to 40
500,000	500,000	500,000	400,000	1,000,000	800,000	400,000	350,000	1,000,000
3.5	3.5	3.5	3.5 (low)	3.5	5.25	3.5	3.5	3.5 (low)
5.3	5	5	11	23	24.1	11	5.35	12.1
4.3	3.9	4	6	20.7	22.8	11	5.35	9.4
0.5	0.4	0.7	N/A	N/A	N/A	3	1	N/A
3	3	3	3	5	5	3	3	5
800-262-9867	800-262-9867	800-262-9867	800-624-5545	See Web site	See Web site	See Web site	800-832-4778	800-832-4778
303-447-0044	303-447-0044	303-447-0044	408-894-4000	408-438-8111	408-438-8111	408-438-8111	714-932-5000	714-932-4900
http://www.maxtor.com	http://www.maxtor.com	http://www.maxtor.com	http://www.quantum.com	http://www.seagate.com	http://www.seagate.com	http://www.seagate.com	http://www.wdc.com	http://www.wdc.com
1065	**1066**	**1067**	**1068**	**1069**	**1070**	**1071**	**1072**	**1073**

*Data represents IBM's design objectives and is provided for comparison among IBM products. Questions or concerns about data should be referred to an IBM representative. Product data and specifications are subject to change without notice.

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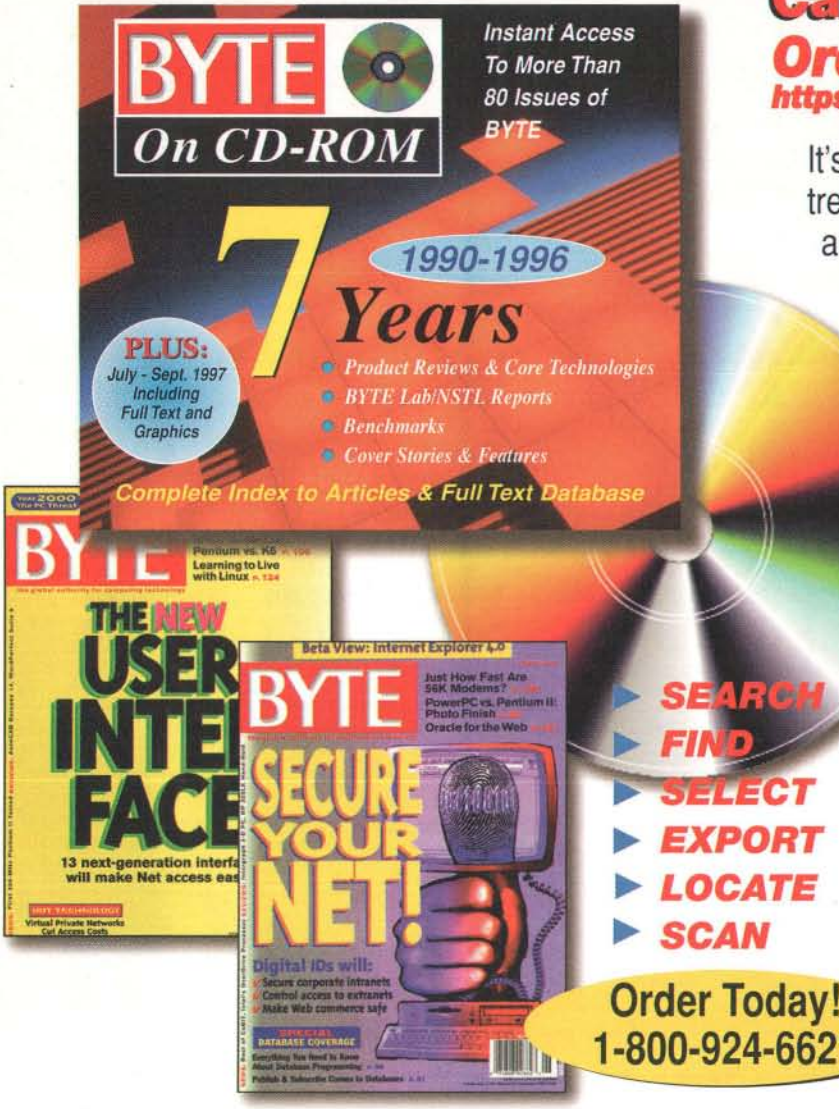

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Storage: Part II

Infinite Space

Storage technologies keep advancing, and into some very strange places.

By Edmund X. DeJesus

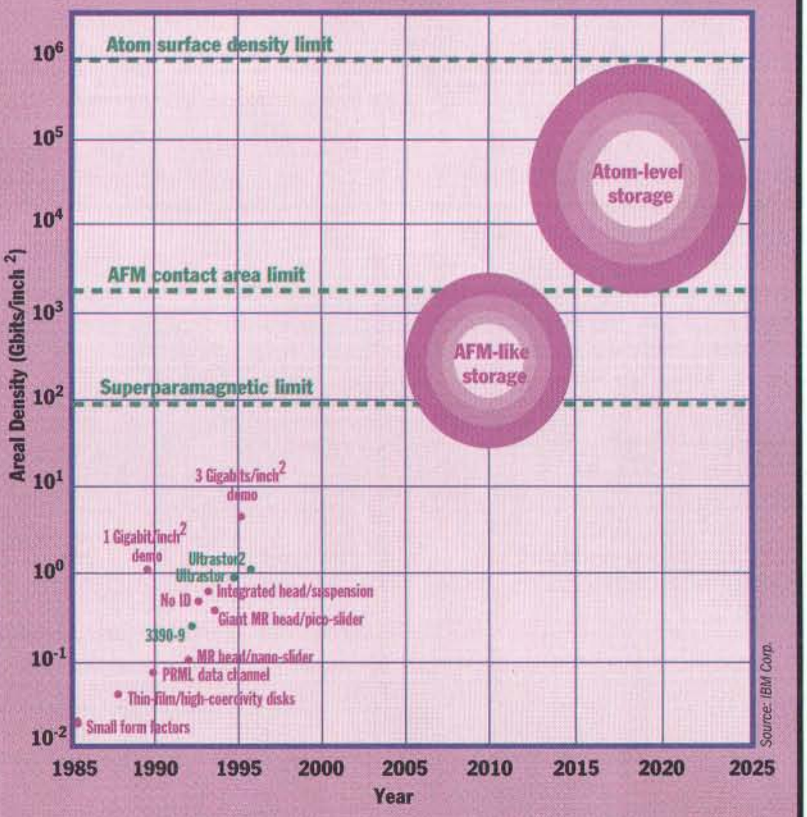
Some very clever people are thinking about storage. That's good, because the rest of us don't want to think about it at all. We just want an infinite amount of space to store anything we please and be able to access it instantly. And we want it to be inexpensive. Is that too much to ask?

Apparently not, because hard drive manufacturers have been successfully meeting those rather demanding specs since Day One. Hard drives continue to get smaller yet more voluminous, faster yet more accurate, and cheaper yet more complex. Clearly this yellow brick road cannot continue forever. Luckily, the end leads to the Oz of computer storage: polymeric holograms, clusters of manganese molecules, and individual atoms of uranium. Oh my.

Head Case

The most expensive, and probably the most complex, part of a hard drive is the head that reads and writes data on the platter. Since heads are the primary cost of a hard drive, and since hard disk sales depend primarily on cost, the cheaper the head, the more successfully the drive will sell. This is not exactly a motivation for vendors to experiment with new, but pricier, technologies. Buyers could care less what kind of heads are in the drive: They are looking at the bottom line. (In this same issue, you can get the latest information and performance ratings of today's best hard disks. Our Lab Report tests will help you pick the best drives for workstations and servers, in capacities ranging from 4 to 23 gigabytes. See "15 Disks Cover More Data Than Ever," page 112.)

Denser and Denser

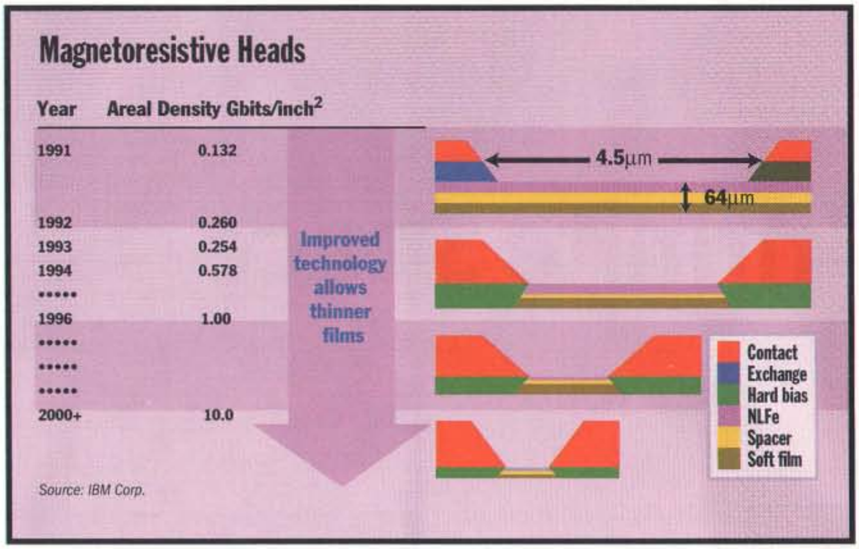


Source: IBM Corp.

IBM has demonstrated areal densities of three billion bits per square inch. There are about 10 million billion atoms per square inch on the surface of the disk. If data density continues to increase at the same rate it has in the past—a very big "if"—the physical limits of magnetic storage could be reached sometime early in the next century.

Magnetoresistive (MR) heads continue to supplant older inductive heads. (Magnetoresistance is the property by which a material's resistance to electricity changes in a magnetic field. Magnetoresistive heads use this property to detect magnetic fields on hard disks.) Drives with magnetoresistive heads now claim some 50 to 60 percent of the market, and their share is growing, according to Jim Porter, president of Disk/Trend (Mountain View, CA), an analysis com-

Magnetoresistive Heads

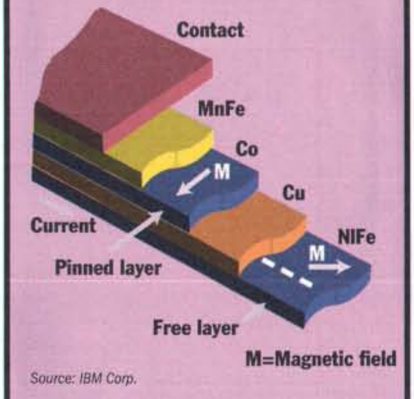


Year	Areal Density Gbits/inch^2
1991	0.132
1992	0.260
1993	0.254
1994	0.578
•••••	
1996	1.00
•••••	
•••••	
•••••	
2000+	10.0

Source: IBM Corp.

Magnetoresistive heads can continue to achieve higher areal densities as the contact gap reduces.

Giant Magnetoresistive (GMR)



Source: IBM Corp.

GMR heads consist of materials very sensitive to small magnetic fields.

pany that tracks the storage industry. Not surprising, given what is possible with this "older" technology. Already, MR drives are available from Seagate and IBM that hold more than 18 GB in a 3½-inch form factor and more than 45 GB in a 5¼-inch form factor. By the time you read this article, other companies will probably also be offering MR drives. Tweaking MR drives further (by diminishing the distance between MR head contacts, already measured in microns) will probably give them another 3 to 4 years of life. By then, MR will probably have run its course and not be able to support the higher areal densities possible with newer drive technologies.

What kinds of technologies? The most likely contender is the *spin valve head*, which uses giant magnetoresistive (GMR) effects. IBM developed GMR and spin valve heads, which rely on the exquisite sensitivity to magnetism of a thin conducting (but nonmagnetic) layer between conducting and magnetic layers. Spin valve heads increase the areal density some 10 to 20 times that of MR heads, to 10 to20 gigabits per square inch.

Naturally, the GMR heads cost more than the MR heads, which is one reason they've been biding their time in the wings for a decade (IBM first discovered the effect in 1988). Still, it seems like their time has finally come. In November 1997, IBM released its very first hard drive using GMR technology; it stores 16.8 GB in a 3½-inch form factor for PC desktops (2.6 gigabits per square inch). IBM expects to move all its hard disk products to GMR technology. Analyst Porter thinks it likely that more GMR heads will make their commercial debut in 1998, probably from IBM, Fujitsu, Hitachi, and Seagate. These devices could initially have 10 to 20 times the capacity of MR drives.

As Porter points out, this is all part of the historical trend in areal densities of hard drives. Areal density has been growing about 60 percent per year, and that trend seems to be continuing. One implication is that areal density increases tenfold every five years. Within five years we could very likely have hard drives that hold hundreds of gigabytes.

GMR and spin valve technology are not the end of the line for hard disk drives. Already scientists at IBM are talking about "colossal" MR, and MIT researchers are at work on tunnel junction magnetoresistance. Both of these technologies could provide more storage density than GMR.

There is, of course, a limit to what you can record and read magnetically. This is called the *superparamagnetic limit*. Basically this means that the tinier the magnetic domains are in which you record information, the less stable they become. Eventually these domains would become so small that they would not be stable enough to hold information reliably. Engineers like to argue about what this limit is, but certainly something on the order of 100 gigabits per square inch is a reasonable high-end figure. Note that the hard disk technologies described earlier are rapidly approaching this limit.

Still, there is clearly more ore to be mined in the rotating magnetic hard disk. But there are also some other storage technologies that branch radically into different directions.

Packing Light

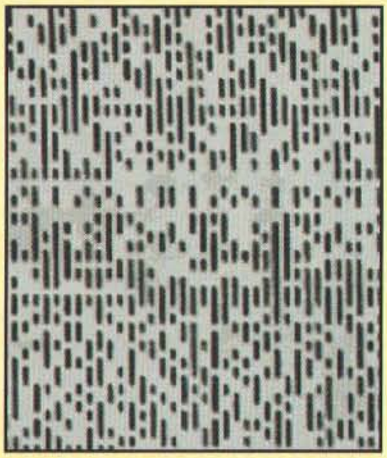
Holographic storage is one of those technologies that experts say is about five years from becoming practical—no matter when you ask them. As of today, that would be after the turn of the century, around 2003.

This is not because holography is something new and mysterious. On the contrary, holography itself was discovered shortly after the invention of the laser. To form a hologram of an object, you shine one low-power laser at the object and an identical (reference) laser at photographic film. The laser light bouncing off the object forms an interference pattern with the reference laser light, and the photographic film records that interference pattern. The photographed pattern looks nothing like the object: It looks like gray and black smears and splotches. But when you shine a laser beam through the pattern (like a slide in a projector), you can see the entire object—in three dimensions. Weirder still, you can cut the film in half and the remaining half could still reproduce the entire original image.

Atomic Force Microscope: It's the Pits

CD-ROMs record their information in the form of tiny pits in the surface. A laser reads the information from the pits. Now CD-ROMs already hold lots of data. But what if you could make the pits really, really tiny?

How tiny? Oh, a few atoms deep. That's one of the technologies that atomic force microscopy is able to perform. An atomic force microscope (AFM) uses an extremely tiny conducting stylus that is very close to a surface. By placing a small charge on the tip of this stylus, it is possible to move single atoms around on the surface. (IBM scientists demonstrated this by spelling out "IBM" using individual xenon atoms.)

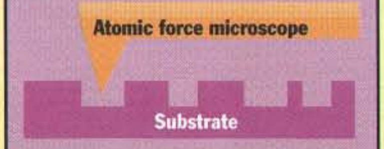


AFM put data on this substrate at a density of 64 Gbits per square inch.

In this new use for the AFM, heat is applied to the stylus, which is placed on a cantilever that can rock up and down. When the cantilever moves down, it can gouge out a few atoms from the rotating surface. This writes data onto the surface. One system uses a laser to detect that there is a pit, reading the recorded data. Another system uses the stylus tip itself to read the indentations. The whole AFM shebang is actually created as part of a silicon chip-like structure, with the cantilever as a tiny moving part. After you have recorded your information once, you can stamp out duplicates in much the same way as with CD-ROMs.

AFM: In the Pits

Atomic force microscope moves up and down, scooping pits out of substrate.



Source: IBM Corp.

This write-once/read-many storage system can achieve densities of 100 gigabits per square inch under practical operating systems. The upper limit seems to be about 300 gigabits per square inch. Since the AFM mechanism is essentially a solid-state system (with its one moving part), it is also a fairly stable system. But there are even bigger (or smaller) deals to come.

Eventually scientists figured out how to make the 3-D image visible to the eye with ordinary light (a white light hologram). Now these 3-D holograms appear on software boxes and credit cards to signify that they're genuine.

None of this has anything to do with holographic storage, except for one thing. The idea that you can take three-dimensional images (data) and save them in a two-dimensional format (hologram) suggests an incredible saving of space to store information. It would be like replacing your file cabinets with pictures of them painted on the wall.

Turning this into a practical storage system means overcoming several obstacles. For one thing, lasers started out as large, delicate, expensive, and ungainly pieces of laboratory apparatus, while a viable storage system would need to take the rough-and-tumble life of computer equipment. Second, since you presumably want to be able to record and read data many times, you need a material that can become dark or light—and stay that way until you change it—over and over again. Third, this material would have to be accurate, reliable, and quickly accessible. Finally, it would have to be cheap.

Each of these obstacles is being knocked down by advancing technology. For example, every portable CD player has a laser in it, in the form of a solid-state laser diode. Since these laser diodes routinely withstand motions like jogging, dancing, and reckless driving, the relatively sedentary existence of a computer should not be a problem.

At first, the problem of a suitable medium seemed to depend upon naturally occurring crystals of photosensitive substances, which would be quite expensive to find and use for holographic storage. The problem of developing a suitable storage medium has brought the Photorefractive Information Storage Materials (PRISM) program into existence, paid for by the U.S. government (natch) and a group of interested companies including GTE, IBM, and Rockwell. Research has concentrated on difficult-to-produce artificially grown iron-doped lithium niobate, strontium barium niobate, bismuth silicate, and barium titanate crystals.

It might also be possible to use special polymers as the photorefractive medium. Dr. William E. Moerner discovered photorefractive polymers while working at IBM's Almaden Research facility. In these special polymers, laser light causes an optical nonlinearity that allows the formation of dynamic holograms. The original hologram was 125 microns thick, and two laser beams could write and read the information. Dr. Moerner, now at the University of California at San Diego, is working toward improving this polymer-based holography system, including increasing the time that the polymers can retain the images.

These photorefractive polymers may change the whole holographic ballgame. For one thing, they will probably be cheaper than the previously used inorganic crystals. Also, polymers are easier to make and mold into different shapes.

How voluminous could holographic storage be? Eventually you could store the *Encyclopædia Britannica* on a hologram the size of a dime. Theoretically, the potential storage density could be as high as 1 terabyte per cubic centimeter (about the size of a sugar cube). More practically, densities of 10 GB per cubic centimeter seem reasonable. A terabyte would fit in the space of a paperback book, or a few cubic inches.

Access would be fast, too. Since holograms store data in two-dimensional planes (or pages or sheets), reading a hologram delivers an entire plane of information. The throughput of such a system could be on the order of 1 Gbps. That's fast, much faster than hard drives of any type, and faster than most computers can handle. Time to bulk up that RAM cache.

One strange advantage of holographic

storage has to do with the nature of holograms themselves. As noted earlier, you can lose half of a 2-D hologram and still recover the entire image. A similar effect is true with holographic storage. As opposed to hard drives, where losing a single stored bit can ruin your whole day, losing a dot in a hologram doesn't affect your ability to access your data at all. You still get everything you stored.

Itsy Bitsy Magnets

If you want to use very tiny magnets, you can't get smaller than a few atoms. That is precisely what researchers have done with what are called *nanomagnets*. For example, a collaboration of scientists in Florence, Rio de Janeiro, and Grenoble has been working with clusters of manganese ions. In particular, at temperatures of 4°K, 12-ion clusters of manganese retain their magnetization for some time. Obviously, that would be important for storage of data.

What is even more interesting for storage, however, is that this ion cluster shows *hysteresis*. This means that applying a particular-strength magnetic field to the clusters causes them to take on one of two magnetic states. This binary-type behavior is precisely what computer storage requires. And the clusters of ions, on a near-molecular level, imply amazingly large densities of information.

Naturally, there are many technical obstacles to this type of storage. Since the clusters themselves are so small, it is difficult to manipulate them. What's more, there is no easy way to access single clusters, either to apply an external magnetic field selectively or to read the state of a cluster.

Let Me Atom

What could be smaller than clusters of atoms? Single atoms. The atoms would have to be powerfully ionized in order to have detectable effects. Fortunately, nature provides atoms that can become powerfully ionized. Unfortunately, the atoms are uranium.

Uranium has the highest atomic number of any naturally occurring atom. Since uranium has such a high atomic number, stripping away its electrons leaves it powerfully ionized. Scientists at Lawrence Livermore National Laboratory have been able to do exactly this. If the process could ever be made practical, these highly ionized atoms could form the basis for storage on an atomic level.

Clever people keep developing clever ideas for computer storage, from products you can hold in your hand to concepts built around something as small as an atom. Whether all these great ideas ever turn into viable technologies is not important. What is important is that some of them definitely will. Lucky for the rest of us. B

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WHERE TO FIND

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Quality the World Trusts

Pull out the old and push in the new with reliable and scalable P&S middleware. By Pete Loshin

Publish and Subscribe Meets the Internet

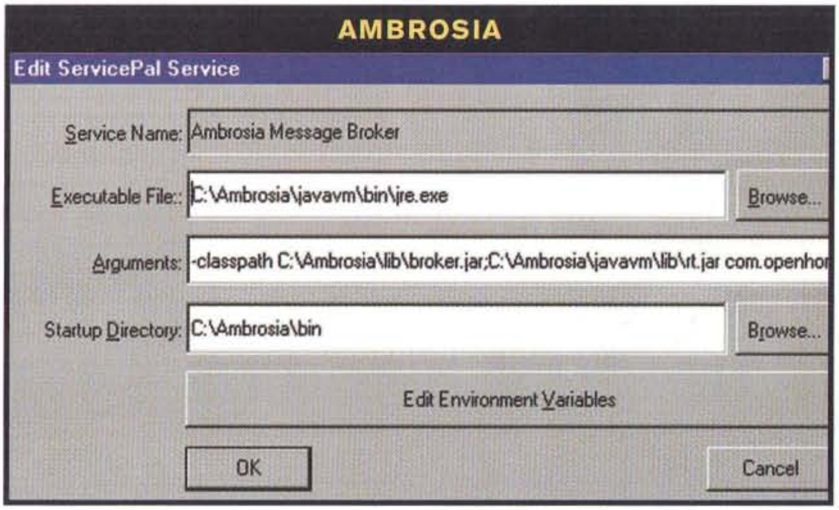
When it works the way it's supposed to, middleware disappears into the background of an organizational infrastructure. Publish and subscribe (P&S) middleware, which occupies the middle ground of the middleware world (see the text box "Monkey in the Middleware" on page 126), is no different.

Sometimes referred to as pull software or smart-push software, P&S middleware enables information consumers to subscribe to particular messages (sometimes known as *data events*, to distinguish them from e-mail-type messages) while making it easy for information producers to publish data events. P&S products can keep a lid on network traffic, even when there's lots of data and many subscribers, by using message routers and multicast transmission to distribute information.

I examined three leading P&S solutions: Open Horizon's Ambrosia, Talarian's SmartSockets, and Tibco's TIB/Rendezvous. These products typically become an integral part of a large organization's computing infrastructure, using many different platforms, networks, and architectures, as well as different applications.

Choosing a tool is more than a matter of finding one that helps you build what you want. Most middleware tasks can be handled by most P&S solutions, but some just work better and are easier to implement than others for a particular application. Architecture, programming API, level of delivery reliability, and availability of security features, including authentication and encryption, all differentiate these products.

P&S products can solve scalability issues, but different products scale in different dimensions, depending on their architecture and design. The right publish/subscribe solution for your application depends on whether you need to add subscribers, the volume of data to be published, and the size and topology of your transport network.



AMBROSIA

Edit ServicePal Service

Service Name: Ambrosia Message Broker

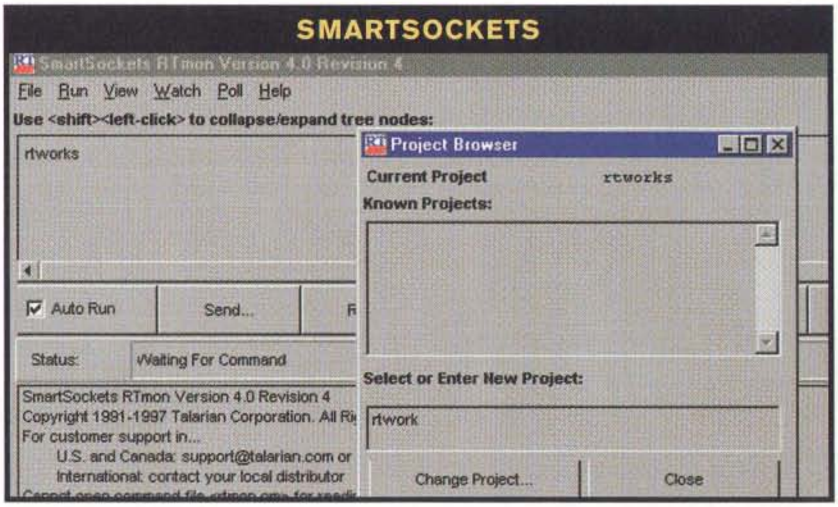
Executable File:: C:\Ambrosia\javavm\bin\jre.exe

Arguments: -classpath C:\Ambrosia\lib\broker.jar;C:\Ambrosia\javavm\lib\rt.jar com.openho

Startup Directory: C:\Ambrosia\bin

RATINGS	
TECHNOLOGY	★ ★ ★
IMPLEMENTATION	★ ★ ★
PERFORMANCE	★ ★ ★

Ultimately, the best approach to buying any type of middleware is to run your own tests with your own applications.



SMARTSOCKETS

SmartSockets RTmon Version 4.0 Revision 4

Use <shift><left-click> to collapse/expand tree nodes:

rtworks

☑ Auto Run

Status: Waiting For Command

SmartSockets RTmon Version 4.0 Revision 4
Copyright 1991-1997 Talarian Corporation. All Ri
For customer support in...
U.S. and Canada: support@talarian.com or
International: contact your local distributor

Project Browser

Current Project rtworks

Known Projects:

Select or Enter New Project: rtwork

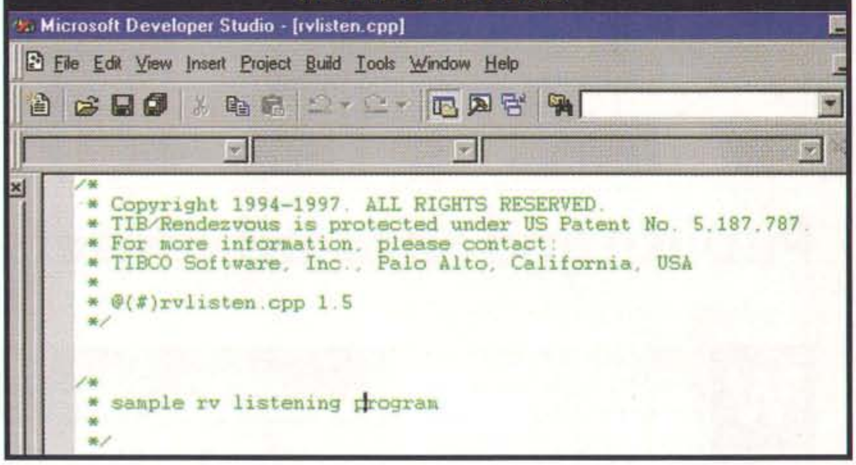
I invited leading P&S middleware vendors to install their latest products in BYTE's lab and supply test programs, but it became clear that P&S performance depends on too many variables to allow

RATINGS	
TECHNOLOGY	★ ★ ★
IMPLEMENTATION	★ ★ ★
PERFORMANCE	★ ★ ★

★★★★★ Outstanding ★★★★ Very Good ★★★ Good ★★ Fair ★ Poor meaningful comparisons. Platform, message size, data type, timing, batching (i.e., the number of messages sent by the publisher at one time), system configuration, available RAM, network bandwidth, the number of publishers and subscribers, and middleware architecture all affect performance and make comparisons difficult. As noted earlier, the ultimate criterion is how well a product works for your own specific application.

I checked the products' baseline functionality, which includes ability to publish and subscribe data, support for security and authentication, quality of service, fault tolerance, and the current de facto and de jure standards. These standards affect the products' ability to interface with the most popular and important protocols, programming languages, OSes, and platforms.

TIB/RENDEZVOUS


Microsoft Developer Studio - [rvlisten.cpp]
File Edit View Insert Project Build Tools Window Help

```
/*
 * Copyright 1994-1997. ALL RIGHTS RESERVED.
 * TIB/Rendezvous is protected under US Patent No. 5,187,787.
 * For more information, please contact:
 * TIBCO Software, Inc., Palo Alto, California, USA
 *
 * @(#)rvlisten.cpp 1.5
 */


/*
 * sample rv listening program
 *
 */
```

Infrastructure Architecture

Traditional client/server programming employs a request/reply model, while P&S (see "Publish or Perish," September 1997 BYTE) enables a producer to publish data and permits consumers to subscribe to it. A broker transmits these data events to its subscribers, eliminating one obstacle to scalability: the need for data consumers to periodically poll for new data. When new data comes in, the middleware delivers it to all the subscribed data consumers (and to them only).

Tibco uses a peer-to-peer multicast on a bus architecture for TIB/Rendezvous: All peers publish or subscribe to messages directly. Any peer can publish data by sending it to a subject at a multicast address, and any system can receive it by subscribing to the subject's multicast address. Each participating system runs a Rendezvous daemon that sends and receives messages on the network. Rendezvous routing daemons can route messages to subscribers on remote LANs. These daemons act as message brokers because they forward messages to their destinations, publishing messages to and accepting messages from the bus for Rendezvous-enabled applications.

RATINGS	
TECHNOLOGY	★★★
IMPLEMENTATION	★★
PERFORMANCE	★★★★

In contrast, Ambrosia employs a peer-to-peer/broker unicast approach. Using a hub-and-spoke architecture, Ambrosia-enabled applications subscribe and publish by opening a TCP connection with an Ambrosia Message Broker process that has the ability to track who's subscribing and who's publishing.

The distinctions between architectures are critical to performance and scalability—which are determined more by the nature of the application than by the P&S middleware being used. For example, using multicast to deliver messages means that local network traffic will be flat no matter how many subscribers there are: An event is published only once to get it out to all subscribers on the network. TIB/Rendezvous uses this model; one IS manager whose company uses this product reported that the network load flattened out after the addition of as few as two to four subscribers.

In a hub-and-spoke architecture, each message passes through a broker or a server. Here you must add message routers as you add subscribers. Therefore, if one message router is just enough to handle 30 subscribers on a LAN, doubling your subscriber base means adding another message router. To complicate matters, there's nothing stopping you from deploying

Monkey in the Middleware

P&S is just one approach to middleware, a category of software that provides a mechanism for connecting different and disparate systems and, increasingly, for supporting truly distributed computing. The following list describes some other middleware approaches.

Remote procedure call (RPC) architectures allow developers to invoke procedures on a server remotely through a procedure call from the client. The server responds to the RPC as if it were invoked locally, simply accepting the client's request and fulfilling it synchronously. Programming with RPCs can be complicated because each client must be designed to interface with the appropriate procedure on the server.

Object request brokers (ORBs) define standards for constructing object-oriented distributed applications. The Common Object Request Broker Architecture (CORBA) defines standards for distributed computing over TCP/IP networks using ORBs to pass requests and responses from any client to any server, as long as they are employing CORBA interfaces.

Transaction processing (TP) monitors coordinate and manage distributed updates across multiple databases from a large volume of clients. These monitors manage interactions between clients and servers with a high degree of reliability, maintaining the state of client sessions to provide transactional-quality service, but usually at the price of a complex implementation.

Message-queueing middleware uses the concept of the queue to transmit messages from one system to another. Relying on queues allows these systems to handle the transmission of data asynchronously between systems that may not be on-line at the same time. The message-queue software forwards a message to its destination when the destination is reachable, saving the message for later delivery if the destination is unavailable. Message queueing offers extremely high reliability, but its relatively low performance can make it unsuitable for interactive applications.

SmartSockets, for example, with multicasting enabled to save bandwidth—or from deploying TIB/Rendezvous using unicast transmissions, with each peer pointed to a routing daemon, to simulate a hub-and-spoke architecture.

Consider an application linking a large number of publishers, each publishing to fewer subscribers, all deployed across a WAN. Implement with a bus architecture like TIB/Rendezvous's, and you will need to have at least one routing daemon at each geographic location to forward messages. Hub-and-spoke architectures also work well for applications requiring explicit involvement of the application with message routing.

Message routers can retain a cache of old messages of variable sizes, so subscribers who miss anything due to system failure can catch up on missed messages. TIB requires each peer be running (or have access to) a Rendezvous daemon to listen for multicast content; message-routing products, like SmartSockets and Ambrosia, rely on their enabled application client software to handle subscriptions.

Open Horizon Ambrosia 2.1

Open Horizon positions Ambrosia as a P&S solution for the Internet. Since Ambrosia is one of the first products to be certified 100 percent Pure Java, Ambrosia peers require only a Java 1.1 virtual machine (VM) and a TCP/IP stack; the broker software runs on Windows NT 4.0 or Solaris. Ambrosia's hub-and-spoke architecture might seem ideal for widely distributed systems, but version 2.1 doesn't support interbroker communications. Instead, it funnels all messaging through a single broker (version 3.0, expected soon, will support interbroker routing).

The Ambrosia message broker routes messages from publisher to subscriber, acting as an intermediary for messages and enforcing delivery reliability (see the text box "Managing Performance/Reliability Trade-Offs" on page 128) and security (it supports encryption). If a subscriber requests guaranteed delivery, the message broker makes sure the message is delivered. The broker handles all authorization tasks, including determining whether a peer is allowed to subscribe, publish, or request guaranteed delivery of events.

Unlike TIB/Rendezvous, which delegates all programmatic policy to the application itself, Ambrosia requires the developer to use the message broker to create

P&S Features

	Ambrosia	SmartSockets	TIB/Rendezvous
ARCHITECTURE			
Peer P&S	✔	✔	✔
Server software	✔	✔	
Client /daemon software			✔
Bus		Logical bus	✔
Hub and spoke	✔	✔	✔ (can be configured)
Message routing		✔	✔
Message switching	✔	✔	
Last value/cache servers		✔	Reliability interval defaults to 60 seconds' worth of data
API			
C/C++	✔	✔	✔
Java	✔	✔	✔
Visual Basic	✔	✔	✔
JavaBean wrapper	✔	✔	
ActiveX	✔	✔	✔
CORBA	✔	✔	Add-on option (Object Bus)
PLATFORM SUPPORT			
DOS			
Windows 3.x	✔[1]	✔	✔
Windows 95	✔	✔	✔
Windows NT	✔	✔	✔
Unix	✔	✔	✔
VMS	✔[1]	✔	✔
MVS	✔[1]	✔	✔
OS/2	✔[1]	✔	✔
Macintosh	✔[1]		
VxWorks/QnX		✔	VxWorks only
OS/400	✔[1]		✔
QUALITY OF DELIVERY			
Reliable delivery (delivered no more than once)	✔	✔	✔
Guaranteed delivery (delivered at least once)	✔	✔[2]	✔
Transactional delivery	✔	✔ (secure version of SmartSockets)	TIB/Data now in beta; will provide security over TIB
Authentication	✔ (Kerberos-style, user ID and passphrase)	✔ (Kerberos)	
Key exchange	✔ (internally used only, not exposed)	✔ (Kerberos)	
Encryption	✔ (DES)	✔ (DES)	
Digital signature	✔ (internally only for integrity checks for DSA)		
LICENSING			
Developer's kit price	$5995	$4500	$5000
RUN-TIME			
Cost per seat	$14,950 cost per hub includes 50 users	From $3000 per RTserver (Win NT/95); no per-seat charges	$600
Server-peer software	N/A	N/A	$3000
Miscellaneous	Message-format repository: Define messages to query fields and values	Secure version add-on: $5000 package for Kerberos and Kerberized implementation of SmartSockets	TIB/Rendezvous Pro and TIB/ObjectBus each cost $1500 per client desktop and $6000 per server

[1] Supported through Java on these platforms.

[2] Can also be configured to do guaranteed delivery to some subset of all subscribers.

✔=yes; N/A=not applicable.

program policies, such as who can publish and who can subscribe. The Admin console lets you manage access policies for individuals or groups and monitor messages by subject.

Ambrosia builds on Java's security interfaces for user authentication, authorization of users for particular operations, DES encryption, and integrity checking via a secure digest. Expected at the start of this year is support for triple-DES encryption and public-key authentication.

TECH FOCUS DELIVERY

Managing Performance/Reliability Trade-Offs

A hierarchy of reliability levels exists for P&S products, which tend to trade performance for reliability. The baseline level (often called "reliable delivery") is to publish data no more than once. Thus, subscribers who miss messages due to downtime or a network error might never receive them unless a message cache is running. Last-value and cumulative caches (which store the last piece of data, or an accumulation where appropriate) can help improve reliability without affecting performance. Reliable delivery enhances performance because the publisher doesn't have to waste time listening for complaints from subscribers. It works well for both multicast and broadcast transmission.

The next-highest reliability level uses negative acknowledgments (NAKs) from subscribers to alert the publisher that a message needs to be retransmitted. This means messages are retransmitted only when a subscriber misses one and transmits a NAK asking for a retransmit of the missed message(s). The result is that every subscriber receives every message at least once, and sometimes more than that. NAKs work well for multicast transmission because publishers can depend on its subscribers to act as squeaky wheels: If they don't say anything, it's because they're getting everything they need.

For even more reliability, you can move up to what Tibco calls certified delivery, which is available in the optional TIB/Rendezvous Pro product (which also supports distributed queueing and includes a fault-tolerant API; transactional messaging is available in a separate product, Enterprise Transaction Express). TIB/Rendezvous certified delivery requires each subscriber to positively acknowledge (ACK) receipt of each message to the publisher, although the messages are published by multicast. Positive acknowledgment is also an option for unicast publishing.

You can get even higher reliability by adding a mechanism that can keep track of all messages, approaching the type of structure provided by message queues (see "Monkey in the Middleware" on page 126). Digitally signing or encrypting messages can also add a sense of security to reliable delivery.

Talarian SmartSockets 4.0

With its 14 pounds of documentation, SmartSockets scored tops in volume of support materials, including tutorials with step-by-step instructions and sample code. SmartSockets' hub-and-spoke architecture supports true message routing between message brokers for wider scalability across WANs. RTserver, SmartSockets' message broker, routes messages directly to subscribers or to intermediate message routers. Multicast transmission is available as well, for reducing traffic on a LAN.

Even so, Talarian describes the architecture as a "logical bus," which means peers publish messages into the logical bus and other peers subscribe by tapping into that bus. SmartSockets is very much a message-routing product, using OSPF (Open Shortest Path First) routing to efficiently route messages from publishers to subscribers.

SmartSockets rates high on reliability, supporting hot failover between message routers, as well as other types of load balancing. The package supports DES encryption but lacks public-key support.

Tibco TIB/Rendezvous 4.1

Tibco's TIB/Rendezvous event-driven middleware employs a bus architecture: Everything is published directly to the bus. Relying heavily on multicast, Rendezvous-enabled applications scale incredibly well when implemented appropriately. The publisher publishes one message, which can be subscribed to by processes running on any or all systems on the network. Adding subscribers impacts network traffic only minimally, since subscribing is a matter of the subscriber's publishing a message announcing its subscription.

Intranets, extranets, and the Internet complicate matters. Extending the TIB bus to WANs requires the routing of messages. The Rendezvous routing daemon, rvrd, forwards messages subscribed to by other routing daemons on behalf of systems on other networks. TIB/Rendezvous routers use subject-based routing to minimize internetwork traffic: Only messages subscribed from outside a site are forwarded.

Creating a channel to publish data with Rendezvous is easy, but integrating existing applications can be more complicated. Reliance on a daemon means that all Rendezvous-enabled applications can share access to the P&S bus.

Cost and Suitability

Overall, the suitability of any of these products to your application depends on what that application is and how you want to deploy it. After deployment, these products make publishing data simple, but building the application can be trickier.

Cost considerations are also important. Although the raw cost of the software license is important, with per-seat costs for a fully functional TIB/Rendezvous peer starting at $600, the expense of developing and deploying your application must also be considered. Expect to devote considerable effort to designing your event namespace and the interfaces between legacy applications and whichever P&S architecture you choose. ■

BYTE technical editor Pete Loshin is the author of Personal Encryption Clearly Explained *(AP Professional, 1998). He can be contacted at* **pete@loshin.com.**

PRODUCT INFORMATION

Ambrosia 2.1
developer's license starts
at $5950; deployment
systems start at $14,950
Open Horizon, Inc.
South San Francisco, CA
650-869-2200
fax: 650-869-2201
http://www.openhorizon.com
Enter HotBYTEs No. 1023.

SmartSockets 4.0
$4500 for developer's toolkit;
server starts at $3000
(Windows 16/32, Unix [assorted],
DEC OpenVMS, IBM MVS
and OS/2)
Talarian Corp.
Mountain View, CA
650-965-8050
fax: 650-965-9077
http://www.talarian.com
Enter HotBYTEs No. 1025.

TIB/Rendezvous 4.1
starts at $600 per desktop and
$2500 for developer's kit
(Windows 16/32, Unix [assorted],
Next, IBM OS/400 and MVS,
DEC OpenVMS)
Tibco Software, Inc.
Palo Alto, CA
650-846-5000
http://www.tibco.com
Enter HotBYTEs No. 1024.

at http://www.byte.com/hotbytes/

Hewlett-Packard's LaserJet 4000 brings better performance in a smaller package and ushers in a new communications standard. ***By Alex Pournelle***

HP Makes an Even Better Impression

Hewlett-Packard's newest workgroup printer, the LaserJet 4000, bests its predecessor, the LaserJet 5, in speed and compactness. The 17-page-per-minute printer—BYTE's Best of Show winner at Fall Comdex—also introduces a communications technology, called JetSend, that could become the lingua franca of all network devices.

I tested the 4000TN, which has two 250-sheet paper-input trays, a manual paper tray, 8 MB of RAM, and comes with JetDirect 600N print server software. Its new features include a 1200-dot-per-inch (dpi) marking engine and a 100-MHz NEC VR4300 processor.

Hewlett-Packard LaserJet 4000TN
$1599

Hewlett-Packard Co.
Santa Clara, CA

800-752-0900

http://www.hp.com

Enter HotBYTEs No. 1007.

The HP LaserJet 4000 prints up to 1200 dots per inch, at 17 pages per minute, and weighs just 45 pounds.

My first impression of this printer, as usual with HP products, is that it's solid. It installed easily, and it printed every standard PCL 5 or 6 test page I threw at it without incident. With the supplied work-alike that comes on expansion ROM, it also printed PostScript. Additionally, the ProRes 1200-dpi setting, which runs the engine at half speed, produced noticeably blacker blacks than the full-speed FastRes at 1200 dpi.

TECH FOCUS

JetSend: The Future of File Transfers?

Concurrent with the LaserJet 4000's release, HP announced JetSend, a new way for devices to communicate over TCP/IP. Once the kinks are worked out, this technology has the potential to revolutionize the way all documents are moved.

JetSend requires bidirectional negotiation for devices to work out a common format. Whether between a scanner and a remote PC, a hand-held computer and a fax machine, or some other combination, JetSend hides the negotiation of compatible protocols, resolutions, and machine features—all without a network server. In the future, HP plans to incorporate this technology in nearly all its products.

I was impressed with the printer's options and upgrade possibilities. The LaserJet 4000 offers expansion of up to 100 MB of RAM, using three 32-MB SIMMs. Options include a third 500-sheet paper-input tray, 75-envelope feeder, duplex printing handler, PostScript-clone ROMs, and local hard disk storage.

I was also pleased with the LaserJet 4000's drivers, which support bidirectional and parallel communications on Windows NT (though Microsoft won't have native OS support for this until NT 5.0). Bidirectional communication is also available on a Windows or a Macintosh network with the JetDirect 600N Print Server, which comes standard with the 4000TN.

JetAdmin 2.5 software provides network IP address configuration and the ability to view available printer memory and jobs queued. In my tests, JetAdmin did have some problems with NT 4.0 Server. There's a new version, Web JetAdmin 3.0 (which is now available for downloading from http://www.hp.com/cposupport/printers/software/hpwjnten.exe.html), but it was not available at test time.

The LaserJet 4000TN is a fine addition to HP's expansive line of departmental printers. With the PostScript-clone option, and 1200-dpi ProRes, it's also a great desktop publishing printer. For anyone needing a workgroup printer, the potent combination of speed and quality should make this LaserJet the first one to look at. ■

RATINGS	
TECHNOLOGY	★★★★★
IMPLEMENTATION	★★★★
PERFORMANCE	★★★★

Alex Pournelle (Pasadena, CA) is a computer integrator and data-recovery specialist. You can contact him at **alexp@earthlink.net.**

PHOTOGRAPH: STEVEN GREENBERG © 1998

Review

CAD Software

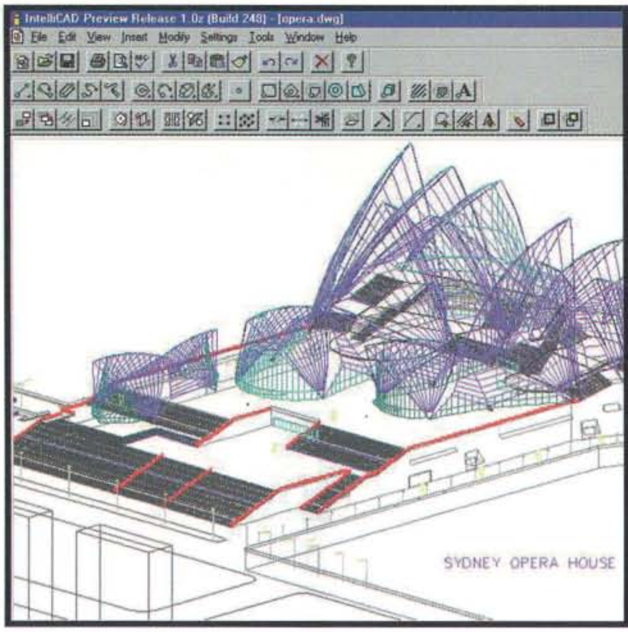
Visio takes serious aim at the 800-pound gorilla of the CAD industry. By Evan Yares

CADzooks! What a Deal

Why is AutoCAD so popular? For 15 years, competitors have asked that question, and none of them seems to have grasped the answer. In my experience, three major factors keep AutoCAD users loyal: an intellectual investment in learning the program, a time investment in customizing the program to do exactly what they need, and a monetary investment in all the drawings they've created.

Many competitors have tried to emulate parts of AutoCAD's command set, customization languages, and DWG file format. But they all started with existing CAD programs, and results were unimpressive. In the real world, "almost AutoCAD-compatible" just isn't good enough.

But what if a company started from scratch, building a program so compatible that AutoCAD users and developers would consider it a desirable alternative? Meet Visio's IntelliCAD, which competes head to head with AutoCAD Release 14 but is $3255 less expensive. It's also got a nice, Microsoft Office-style interface.



IntelliCAD 1.0
$495
Windows 95 or NT;
16 MB of RAM

Visio Corp.
Seattle, WA

206-521-4500
fax: 206-521-4501

http://www.visio.com/

Enter HotBYTEs No. 1026.

Visio's IntelliCAD will look familiar—and feel comfortable—to AutoCAD users.

TECH FOCUS

Custom CAD

AutoCAD has several levels of customization tools. With IntelliCAD, Visio provides full support for those menus and macros, and for AutoLISP (an interpreted LISP language). Compatibility seems to approach 100 percent, except for those few commands that IntelliCAD doesn't yet support.

Professional developers often customize AutoCAD using ADS, a C-language API, and IntelliCAD supports ADS very well. Several developers have reported being able to port their applications to IntelliCAD successfully with just a simple recompile. The one major customization tool that IntelliCAD does not yet support is ARX, a C++ API that allows developers to create custom object types.

I'm an experienced AutoCAD user, and working with IntelliCAD gave me an eerie feeling. Sure, it has all the basic commands. But I also tried dozens of the most obscure AutoCAD commands I know and found only a very few that haven't been implemented in IntelliCAD. Visio provides a list of missing AutoCAD functions, most notably associative hatches, 3-D solids, and photorealistic rendering. Importantly, IntelliCAD doesn't mess up things it can't edit. Using IntelliCAD, I edited files created in AutoCAD 12, 13, and 14. When I saved those drawings and loaded them into AutoCAD, all the objects IntelliCAD couldn't edit were unchanged.

IntelliCAD is more than an AutoCAD-compatible clone; it adds its own significant features. Drawing Explorer, in one window, gives control over layers, line types, blocks, text, and dimension styles. And IntelliCAD has a multiple-document interface, which AutoCAD lacks.

So, will IntelliCAD be an AutoCAD killer? Probably not, but Visio is a serious competitor and Autodesk knows it. IntelliCAD lacks a few AutoCAD features, but it's a well done, viable, mainstream alternative. If you're looking for an industrial-strength CAD program that works with AutoCAD files but won't break the bank, look here. **B**

RATINGS	
TECHNOLOGY	★★★★
IMPLEMENTATION	★★★★★
PERFORMANCE	★★★★

★★★★★ Outstanding ★★★★ Very Good ★★★ Good ★★ Fair ★ Poor

Evan Yares teaches and writes about CAD. You can contact him at **evan@yares.com.**

Jerry Pournelle

Chaos Manor

To Cure a Failing Memory

Jerry's unending quest for more storage space and more RAM leads him into the thicket of disk and memory optimization.

Today's *Daily News* has a Fry's ad: 3.2-GB drives for $160, an astonishing $50 per gigabyte. I suspect that by the time you see this, that price will be standard. This makes disk storage so cheap there's no reason not to have a lot of it without disk compression.

This should have a large impact on Web computers and the like. In a recent *Weekly Standard*, Britt Hume mentions "industry analysts who foresee the day when you won't need to keep any programs stored on your computer except your Web browser." He doesn't say why anyone would be foolish enough to leave critical programs and data at the mercy of not only the telephone lines but the financial stability of a service provider when storage is so cheap. David Em has more on why you need storage space in his graphics report in the Web Exclusive part of this column.

However, large drives do require good disk utilities. You can start with PartitionMagic, from PowerQuest. PartitionMagic partitions your disk; once you've tried it, you won't go back to FDISK. It also examines your disk's partition structure and lets you change it painlessly.

For instance: Cyrus, my Cyrix 6x86 P-166 system, has (according to Windows 95) a 4.4-GB Barracuda drive partitioned into two 2.2-GB drives. Because most programs like to store themselves in C:\Program Files, I'm running low on disk space on the C drive.

There are several remedies. One is to move a lot of data files to the D drive and update the defaults in Microsoft Office and other data-using programs. That works, but it complicates making backup copies; besides, for much of my stuff, I have already done that.

Another remedy is to move a lot of program files from C:\Program Files to S:\Program Files (i.e., to the big dual-Pentium server that hides in the cable room) and access those programs through the network. For some programs this is simple. Others will want the original installation disks—and I don't have them all, meaning I'll have to edit the Registry, which is just a bit more fun than root-canal surgery. Since Cyrus won't be my main machine much longer—I'm changing over to Princess, the Compaq Workstation 5000 that runs Windows NT—I don't need a permanent solution, just a way to get a bit more space.

Large drives do require good disk utilities.

The first thing I did was install PartitionMagic. That uses about 6 MB of disk space, but it's easily uninstalled. More to the point, the program will tell me how much I can gain by repartitioning my hard drive, so I can use smaller cluster sizes.

Forgive me if you know all about cluster sizes. Some readers don't, so I'd better explain. It's also laid out clearly and in detail in the generally excellent PartitionMagic manual.

I'll summarize by saying that the bigger your logical disk drive, the larger the cluster size. The cluster size is the minimum space required to store all or part of a file. In particular, drives sized from 1024 to 2047 MB must, under the current DOS/Windows 95 OS, have a minimum cluster size of 32 KB—and that becomes the smallest file size on your disk.

Thus, if you have a tiny ASCII file, say AUTOEXEC.BAT, the file size may be 88 bytes, but that file will still take up 32 KB on your disk. This wastes space, typically about 30 percent. The larger the partition size, the worse it gets; the wastage can approach 50 percent on systems that have a number of small files.

The remedy is to break that disk partition down to something smaller. A partition smaller than 1 GB, for instance, can use 16-KB clusters and typically results in less than 20 percent wasted space. If you're really into disk organization, you can make one large partition for large files (e.g., the swap file and some program suites), one intermediate size for medium files (e.g., normal program files), and one small partition for little files like saved e-mail. I don't really recommend you do this. I just point out that it's possible.

I was concerned that Windows 95 showed my drives as 2.2 GB, larger than the maximum for 32-KB clusters, making me wonder if I was wasting more space than I needed to by using 64-KB clusters. There may be a way to make Windows 95 tell you what your cluster size is, but I don't know it. Thus, I installed PartitionMagic.

It told me that although Windows 95 thinks my drives are 2.2 GB each, they're really only 2047 MB, and my total wasted space is about 457 MB, or 19 percent. (It also turns out that 64-KB clusters are supported only in NT, not in Windows 95.) I could cut back on the wastage by partitioning the D drive into a D drive for program files and an E drive with 16-KB clusters for saved e-mail. However, it hardly seems worthwhile to recover at most 100

PHOTOGRAPH: THEO FRIDLIZIUS © 1998

MB of disk space. Also, smaller cluster sizes come at a price: with small clusters, it takes longer to access large files, because the disk heads have to move a lot more. If you do make small partitions, don't put your swap file on one of them; it can slow your system down something awful.

There's an even more drastic way to recover that wasted space. I could get the latest version of Windows 95 (version 4.00.950 B or later; you can find your version number in Control Panel/System), which includes FAT32, the new 32-bit file allocation table (FAT) system that allows 8-GB disk partitions with 4-KB cluster sizes.

The problem here is that there's no upgrade to FAT32; you have to back up all files, reformat, and start over. Then, too, the "B" version is still OEM-only. I've heard rumors of an imminent upgrade version, but there isn't one yet. I suspect this is because, while BYTE readers may understand that installing FAT32 is a one-way operation, many users won't.

FAT32 can't share a partition with normal FAT files, nor can earlier versions of Windows 95 (or NT 4.0) read FAT32 files. This applies only to reading local disk partitions; it doesn't affect the ability to access files through a network. A Windows 3.1 system can see and read FAT32 files on a connected system, and vice versa. Of course, if you use a network to move files to a FAT32 system, that is all transparent.

FAT32 is built into Windows 98 (aka Memphis) and is clearly the right way to go, giving you large disk partitions without the penalties of large cluster sizes. However, retrofitting with it isn't something lightly undertaken, even for someone as networked as I am. One day I'll do it, but I'm in no big hurry.

I CONCLUDED THAT TO GET MORE space I'd have to either migrate stuff to the server or experiment with disk compression. My last experience with disk compression was pretty grim, but I have a new program, Mijenix's FreeSpace, that promises compression without pain or fuss. I was skeptical, but it sounded good.

Compression does two things. First, it squeezes redundancy out of files by encoding them. Second, it packs many small files into what the OS sees as one large file, thus eliminating wastage caused by large cluster sizes. The problem with compression is a mirror image of its virtue. To retrieve a file, something has to extract that file from the large compacted file it was stored in and then decode the file into its original form. None of this has to be unreliable, but it adds some complexities to file access.

Now suppose we want to add to that file. We have to find room for the new length and then repack everything. Finally, since many of your compressed files are stuffed end to end into one large packed file, if anything happens to that large file, you could lose them all. Apparently that doesn't happen very often, but it's a chance I'm not eager to take.

FreeSpace is a file (not disk) compression utility with a nifty management structure and a simple user interface. Basically, you install FreeSpace, tell it how much disk space you'd like to make, and stand back. It will recommend which files and folders to compress to get that much. That seemed too good to be true.

First thing, then, was to defrag the disk. There are several ways to do that but only one I trust: Golden Bow Systems' Vopt. I have been using one or another version of Vopt since early DOS days, and I have not had a single problem. Vopt is very careful; it's also considerably more efficient than any other defrag program I've used. When you Vopt a disk, it's really optimized.

I told FreeSpace I wanted to free up 20 MB.

I ran Vopt and installed FreeSpace. I told FreeSpace I wanted to free up 20 MB. The analyzer wizard trundled and then recommended that I compress the Grolier encyclopedia folder. I told it to go ahead, and less than 5 minutes later, I had 22 MB more disk space.

The Grolier program has about 30 MB of stuff on my local disk; it gets the rest from a CD-ROM that resides on a Pioneer SCSI 6-Pack CD-ROM drive on the server. When I ran the encyclopedia, I couldn't detect any difference in its operation after the file compression. Everything works just fine, and if there's a speed difference, I don't notice it.

I was curious now. I used Symantec's Commander 95 and Explorer to look at that folder to see what FreeSpace did; and I blush to say I don't know. If you right-click on some of the files, you'll see a new menu item, FreeSpace, and that will offer to decompress the file. Otherwise, there is no clue that any files have been compressed. Still, Explorer reports 20 MB more disk space available.

It still looked too good to be true, so I told the FreeSpace wizard that I wanted another 40 MB on the C drive. For good measure, it should find me 20 MB on the D drive. It did. On the D drive, there are a huge bunch of mail files, and a lot of game files on the C drive. Once again, if there's any effect on performance, I can't find it.

Then I ran Vopt again. One of the things that used to drive me mad about disk compression on OS/2 was that I had to go to extraordinary lengths to defrag a compressed disk. With FreeSpace, I just run Vopt. When I did, it showed that the disk was seriously fragmented. Apparently, when FreeSpace compresses files, it compacts the ones it compresses, but that can leave a lot of fragmentation among the other files. Vopt soon fixed that.

The bottom line is that FreeSpace has painless compression and decompression. It's extremely easy to use. It will analyze your hard disk folder by folder to determine just how much space it can make for you; and it works just fine. None of my disk utilities know there were any changes in the disk structure; they just see some extra disk space. In fact, it's very hard to see just how FreeSpace works this magic.

FreeSpace doesn't work as well on NT, and clearly it's not going to do much for you in compressing files like JPEGs, which have already been compressed. However, as a quick-and-dirty way to make some more disk space in a hurry, this thing is a blooming miracle. Laptop users with their truly limited disk space will absolutely love this product. Recommended.

VOPT IS WRITTEN BY BARRY Emerson, who seems to know more about DOS and Windows file operations than anyone I know, including Microsoft's people. Vopt has been on my recommended list just about forever. (Truth in reporting: Elizabeth Emerson of Golden Bow has won my "bribe of the month" award several times for elaborate chocolate Christmas presents, but that's not why I like Vopt.) Anyway, about the time you read this, there will be a new version for NT as well as some improvements in the Windows 95 version.

Vopt shows you exactly what is going on, gives a map of just how fragmented your disk is, and works at lightning speed. It's a lot faster than its rivals, despite the fact that it's also more thorough. Disk fragmentation can be a serious problem, especially if you do much Internet surfing. Internet browsers create and delete scads of temporary files. Surfing for a few nights can reduce my hard disk to chattering inefficiency bad enough to make me think the old "hesitation" curse is back with me. Vopt fixes that. Highly recommended.

Actually, I should say that Vopt is a partial cure. I have had hesitations in Word again. I suspected they were caused by disk operations; making disk operations more efficient reduces the time the computer's attention is turned to them. That helps.

I wanted to know why all the disk operations.

But I went further: I wanted to know *why* all the disk operations. What I found out makes a long story—you'll have to read it in the Web Exclusive part of the column—that ended with my installing and uninstalling Quarterdeck Systems' CleanSweep. The reason? I was routinely exceeding Cyrus's 32 MB of memory.

SPEAKING OF QUARTERDECK, some time ago, I said that I didn't see much improvement from their MagnaRam. That turns out to be wrong.

Even though I managed to get my memory usage down below 32 MB by uninstalling CleanSweep, it was still hovering around there, and my stupid hesitations in Word continued. About then, my son Richard spotted the newest QEMM97 and mentioned that he thought MagnaRam, which is included with QEMM97, had helped his system.

I figured anything was worth a try, so I installed QEMM97, which automatically installs MagnaRam, a program that claims to do for RAM what FreeSpace does for disk space, on-the-fly compression. The results were amazing: my hesitations ceased, most disk-swapping operations ceased, and things are very stable. The decrease in disk-swapping operations has been dramatic.

One warning: by default, QEMM97 installs Update-It, a memory-resident program that will go look for Quarterdeck updates on the Internet. That uses several megabytes of memory and surely is not needed. Kill it fast.

Back in DOS and early Windows days, I found QEMM, Quarterdeck's memory manager, indispensable, and I said so often. When Windows 95 rolled out, it didn't look like there was much need for third-party memory-manager programs.

I was wrong. QEMM97 works like a charm, adding memory and resources to your Windows 95 system. While I haven't been using it for all that long, Richard has, and neither of us has had any problems with it so far. It works fine with FreeSpace and Norton System Doctor, its control panel gives you a lot of useful information, and it instantly ended my newest round of hesitations. Recommended.

WHILE I WAS TALKING WITH Barry Emerson about improvements to Vopt, he told me something disturbing. Disk defrag programs move massive amounts of data around. To make sure that everything works properly, Vopt does cyclic redundancy check (CRC) checksums on each file that it moves. Barry has found that in about every 500 GB of data moved, there will be one bit flip: a 0 has become a 1, or vice versa.

He has no idea what causes this; it does not seem to be specific to any kind of file or any kind of hardware. It may be temperature-dependent, but that's an impression; when an event is that rare, it's hard to get decent statistics. "It may be cosmic rays for all I know," he said.

One bit flip in 500 GB is a very low error rate; but given current massive data transfers, it's frightening. The odds are pretty good that the bit flip will be inconsequential or that it will cause a fatal error requiring you to restart whatever operation you were engaged in; but there remains that tiny chance that the bit will flip in an important data file and never be noticed.

I honestly don't know what, if anything, I can do about this. Thus, I merely report it. But it disturbs me.

NOW AN APOLOGY. THE COMEDY of errors started in my November column. CyberMedia's Oil Change recommended that we download DUN 1.2, a Microsoft upgrade to Dial-Up Networking. We did that. We also read about a utility called TweakDUN, from Patterson Design

New Version Released

PKZIP® for Windows

PKZIP® for Windows, the industry standard compression utility, has just gotten better.

PKZIP 2.60 for Windows includes these new features:

- Support for TAR, GZIP, MIME, BinHex, UUencoded & XXencoded file formats.
- Helpful Wizards to assist novice PKZIP users.
- Select a "List File" for adding a specified group of files at once to a .ZIP archive.
- Run an executable file from within an archive without the need to extract first.
- Create shortcuts for a .ZIP file on the desktop.
- Copy, move, delete & rename a .ZIP file from within PKZIP for Windows.
- Easily create new directories when unzipping files.
- Delete .ZIP files to the Windows 95 Recycle Bin.

PKZIP 2.60 for Windows is compatible with Windows 95, Windows NT and Windows 3.1x. PKZIP is also available for DOS, OS/2, SPARC Solaris and Open VMS.

http://www.pkware.com
info@pkware.com
414-354-8699

GENUINE PKZIP® The Data Compression Experts® PKWARE® Inc. Since 1986

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The Data Compression Experts®

BY-298

Systems. It's recommended and apparently codeveloped by NetPro NorthWest; you can find them at http://www.sns-access.com/~netpro/maxmtu.htm#tweakdun, which goes into great detail on what TweakDUN does and why you need it.

We downloaded TweakDUN as well as DUN 1.2 and used them together on Cyrus, which I'm writing this on. They seemed to improve network operations considerably, and the new DUN is certainly more convenient; so we installed them on another machine. The result was a minor disaster that ended with us reinstalling Windows 95; you can read about it in the November issue.

After the November issue came out, I got e-mail from NetPro NorthWest. It has taken me a few days to confirm what they said, but it's true. Alas, when I wrote it up, I seem to have confused the DUN 1.2 upgrade with TweakDUN, and TweakDUN got the blame for our problems. My apologies; I'm not often that wrong.

DUN 1.2 works well when it works, but, for reasons not clear to me, it can on some machines mess up your internal Windows 95 network. TweakDUN is a utility that lets you edit the Registry to change Dial-Up Networking parameters. The result among other things is that multiple Internet activities work better; you can find out more from NetPro NorthWest, whose site is worth visiting anyway. I've heard good things about TweakDUN, and it certainly does no harm. While I haven't yet tried to test how much good it does, I have the impression that it has helped a lot.

Incidentally, I managed to buy two copies of TweakDUN at $12.95 each. Naturally, a story goes with it.

I have the impression that TweakDUN has helped a lot.

Buying the first copy was a pain. There is a free shareware copy, but I generally forget to pay for shareware, so it's simpler to pay when I get it. Trying to pay for TweakDUN led me to the BuyDirect.com page; that one didn't want to accept my American Express card. It never said why. I checked the number and the expiration date, and got the same message: "There's something wrong." Eventually, I figured out that my card has no period after my middle initial, erased the one I had inserted, and downloaded my copy.

I did all this on Princess, which runs NT. Then I transferred the resulting td_12r.exe self-extracting installation file to Cyrus and ran it, getting the error message that "This application uses CTL3D32.DLL, which is not the correct version. This version of CTL3D32.DLL is designed only for Windows NT." I had no idea what program generated that message, except to note that whoever wrote it wasn't very clear on pronoun referents.

Mistakenly—although I think understandably—I concluded that since I had downloaded the file on an NT system, I had somehow got an NT version of it. That was when I fired up Communicator on Cyrus (which runs Windows 95) and bought the second copy of td_12r.exe.

Of course it gave the same error message. Ignoring that message produced the information that I didn't have many Visual Basic 5 run-time programs, but I could get them from http://www.simtel.net/pub/simtelnet/win95/dll/vb5run97.zip.

There's no way to cut and paste from that error message, so out came the logbook so I could hand-copy all that. The first time I fed that URL to Communicator, it did not work. I chopped it back to http://www.simtel.net/, which got me to a place well worth going to: a collection of updates and freeware. Drilling down through its index got me nowhere, but eventually I found a search-engine form, entered vb5run97.zip, and voilà!

That gave me a chance to test a newly installed update of WinZip. I copied vb5run97.zip into a work directory with Symantec's Commander 95, double-clicked on the filename, and up came both EXE and readme files. The readme file warned that installation would be tedious, requiring an installation, reboot, and another installation, but stay with it.

Double-clicking on the EXE file in Commander started the process, which went exactly as described. After this, double-clicking on td_12r.exe, ignoring the message about the wrong version of CTL3D32.DLL, and doggedly proceeding, I installed TweakDUN. WinZip and Commander make a good combination, and both are recommended.

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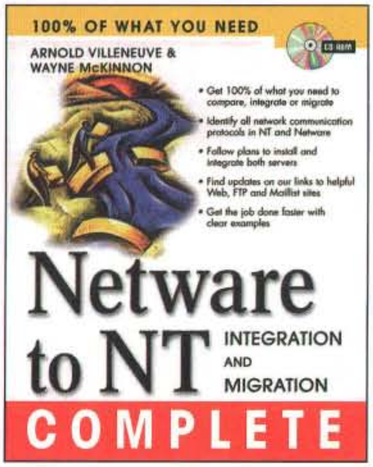
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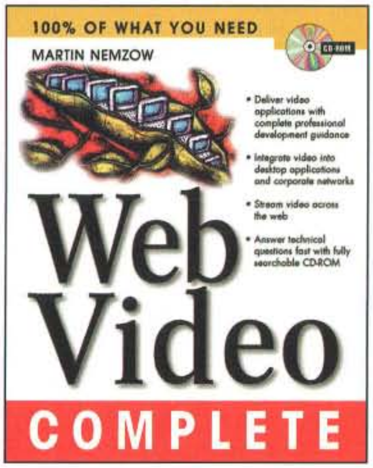
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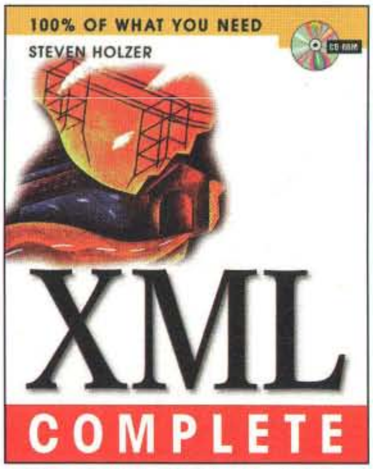

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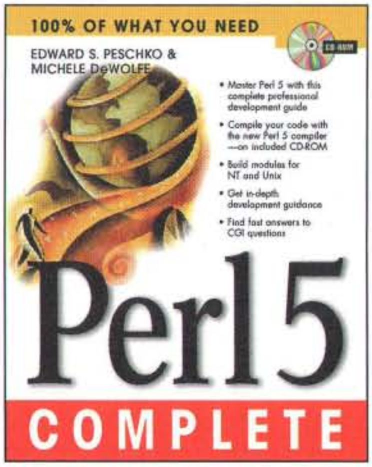
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various Registry entries, while making it easy to restore the defaults. As I mentioned, I haven't actually measured how much good making those changes has done, but a number of people I respect say it's worth doing; and certainly it has done no harm.

Incidentally, this machine is also running DUN 1.2, and that hasn't done any harm either; but be careful.

I'VE BEEN THINKING ABOUT THE big flap over Microsoft's requiring resellers to install Microsoft Internet Explorer (MSIE) 4 as a condition for getting Windows 95, and I think it's a tempest in a teapot.

If you want to be concerned over a Microsoft business practice, get angry over the Sun lawsuit about Microsoft "improvements" in Java that result in Java applications that work in MSIE 4 but not in Navigator. The big attraction of Java is its universality, and Microsoft is doing its best to undermine that. I may be on Sun's side on this one.

THE COMPUTER BOOK OF THE month is *Using Netscape Communicator 4* by Mark R. Brown with Tom Fronckowiak et al. (Que, ISBN 0-7897-0980-5). This book will tell you things about Communicator you didn't suspect you needed to know. It's complete, well organized, and well written. Incidentally, I use Communicator rather than MSIE mostly out of habit. Eric Pobirs, our intern, switched to MSIE 4, which he claims has some outstanding features. So far, though, I haven't found as good a book about MSIE as this is about Communicator.

The book of the month is by Tim Powers, *Earthquake Weather* (Tor Books, ISBN 0-312-86163-X). Powers writes modern fantasy: imagine that the Fisher King of the West has been slain in modern-day Southern California, and Dionysius must be invoked to restore the king. This is a sequel to Tim's *Expiration Date*.

The runner-up game of the month is Interplay's Fallout, about the best "modern" role-playing game I've seen. It takes place in a dark and grim post-nuclear war society of survivors just barely hanging on. As a game it's pretty good, but I am very irritated by games that don't work well in Windows; you have to exit to DOS, and you may even need a boot disk to get this to run. I call that dark ages technology.

The game of the month is Microsoft's Close Combat: A Bridge Too Far. I've seen ads that imply that you can test your skill against Montgomery's in his worst campaign, but that isn't true. This game uses the Microsoft Close Combat engine, and the scale is minor tactics down to the infantry squad; there are no real strategic decisions to make. It's like a real-time Steel Panthers II. I once swore never to play another real-time game again, but in fact the timing on this one is just right, neither too fast nor too slow. It's quite realistic, a good simulation of company-level tactical control that's also fun to play. It installs and runs in Windows 95 or NT without problems. Recommended.

And now I'm taking off to the annual Hackers' Conference, where I'm sure I'll learn a lot. B

PRODUCT INFORMATION

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http://www.microsoft.com
Enter HotBYTEs No. 1074.

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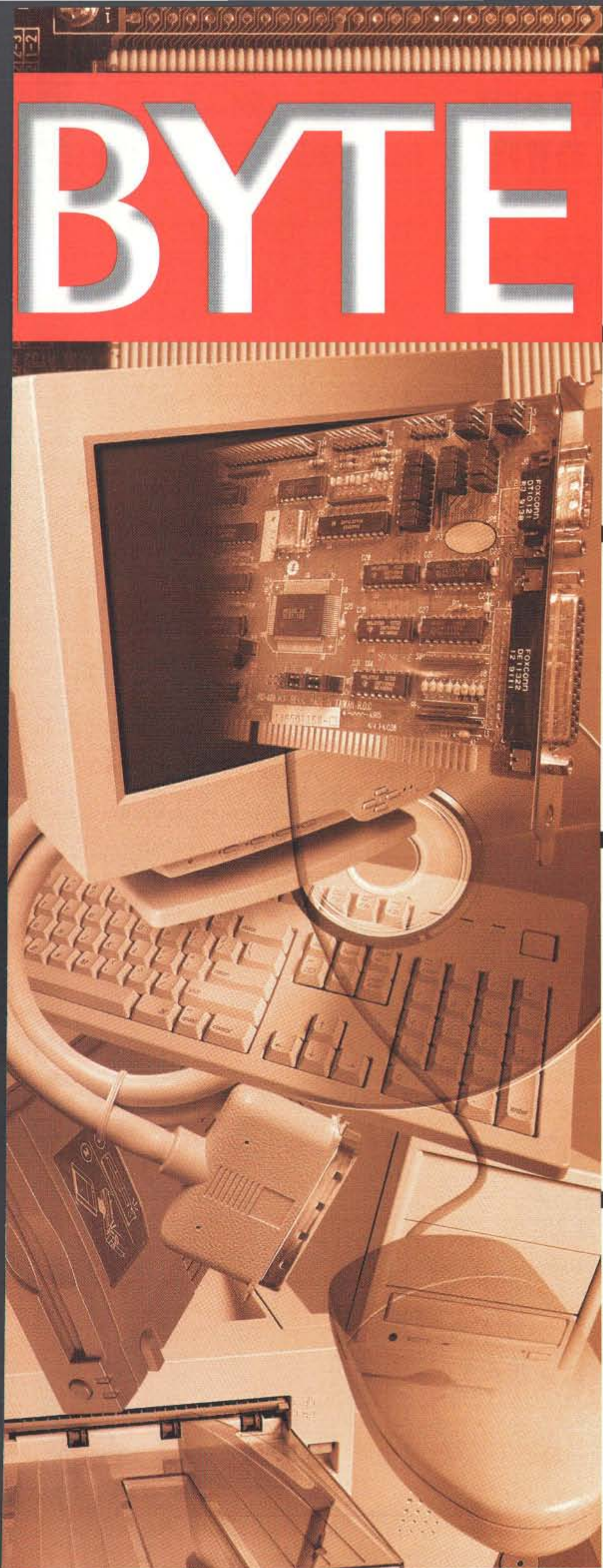

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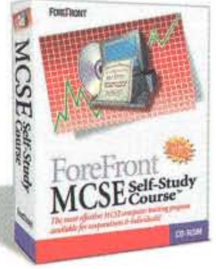

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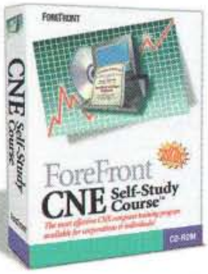

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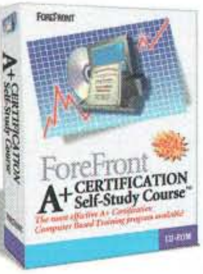

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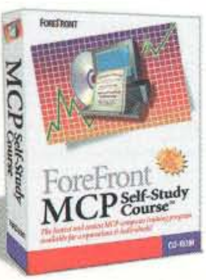

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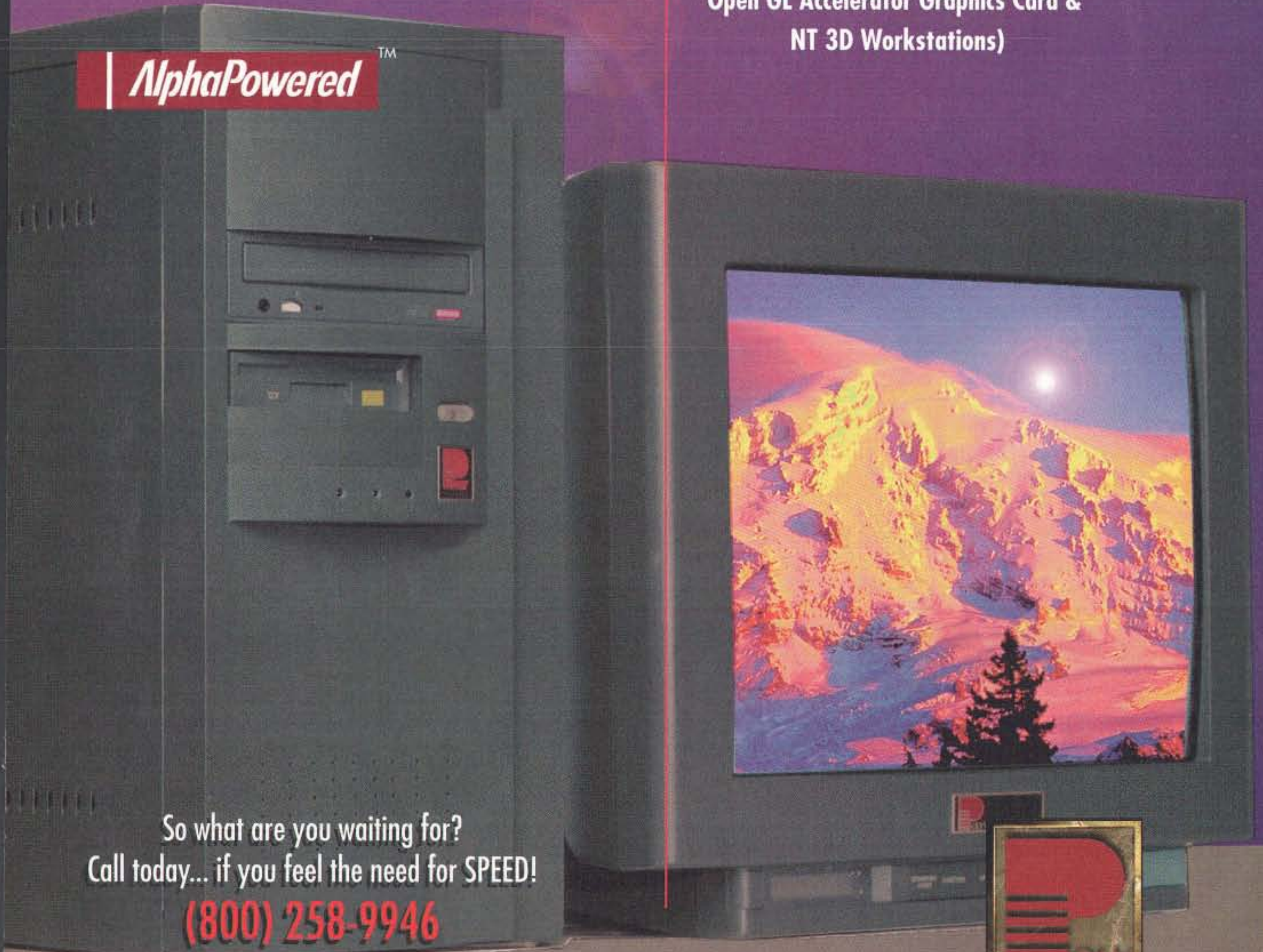

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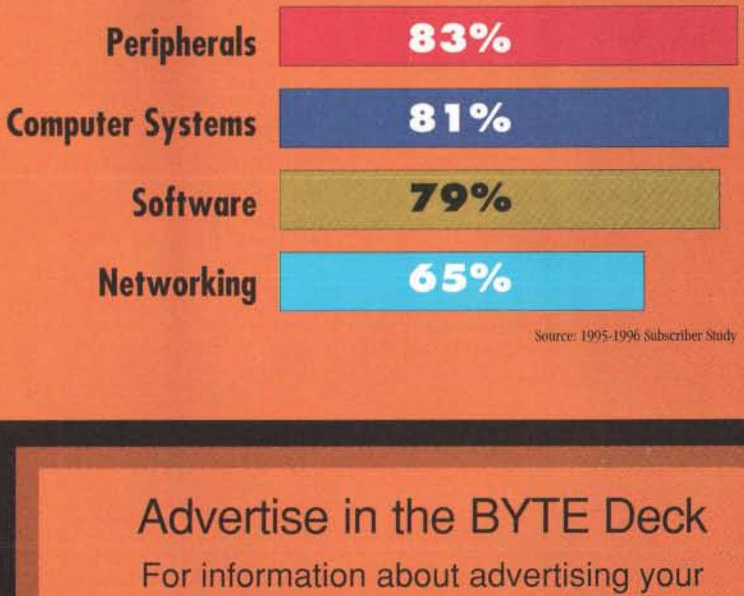

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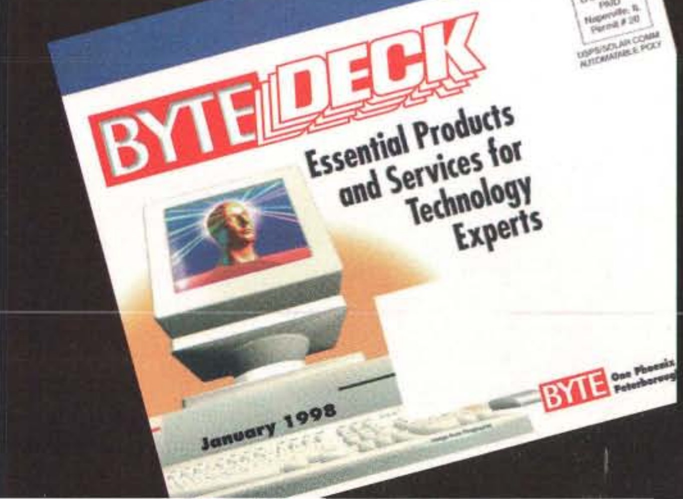

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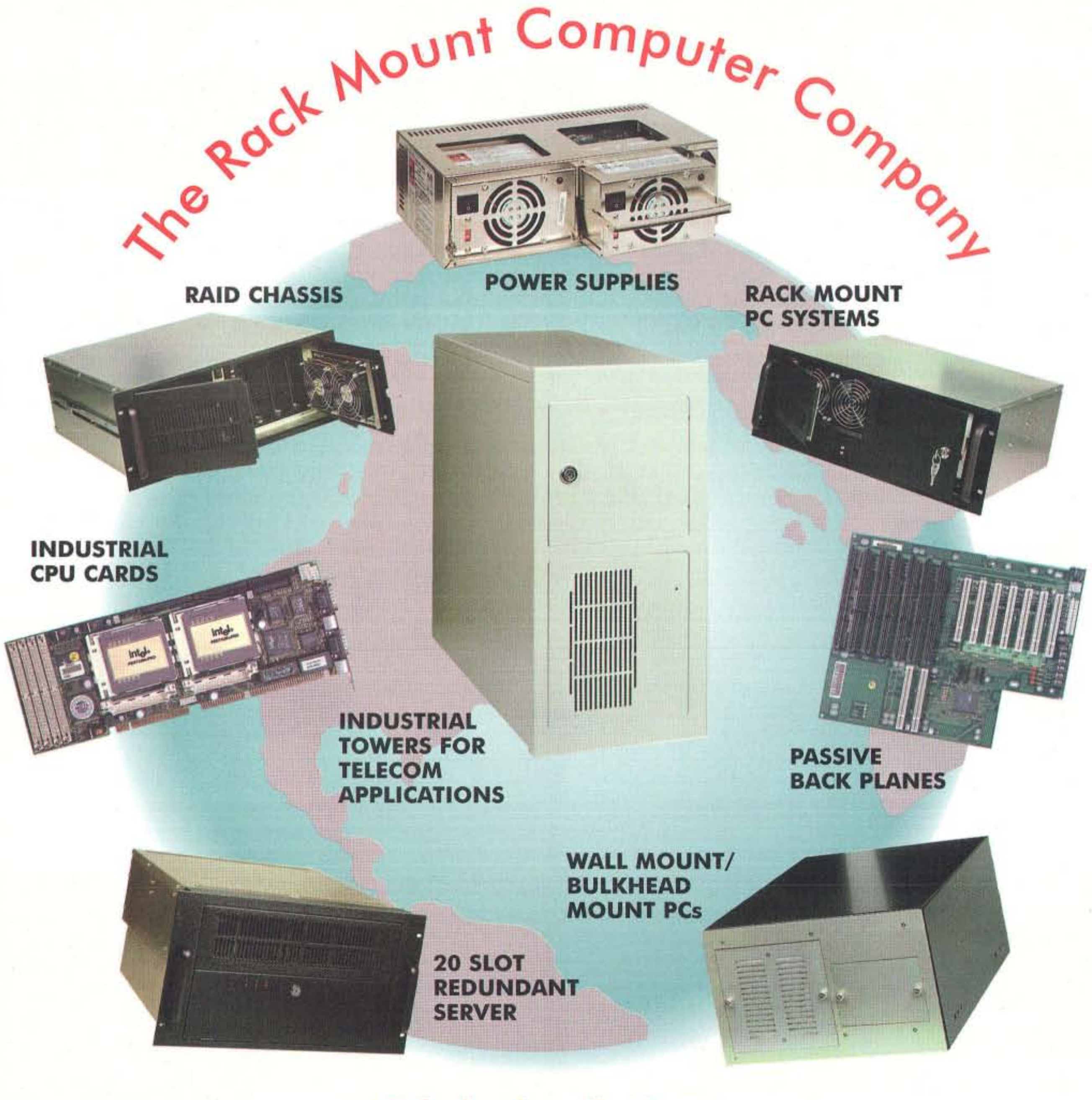

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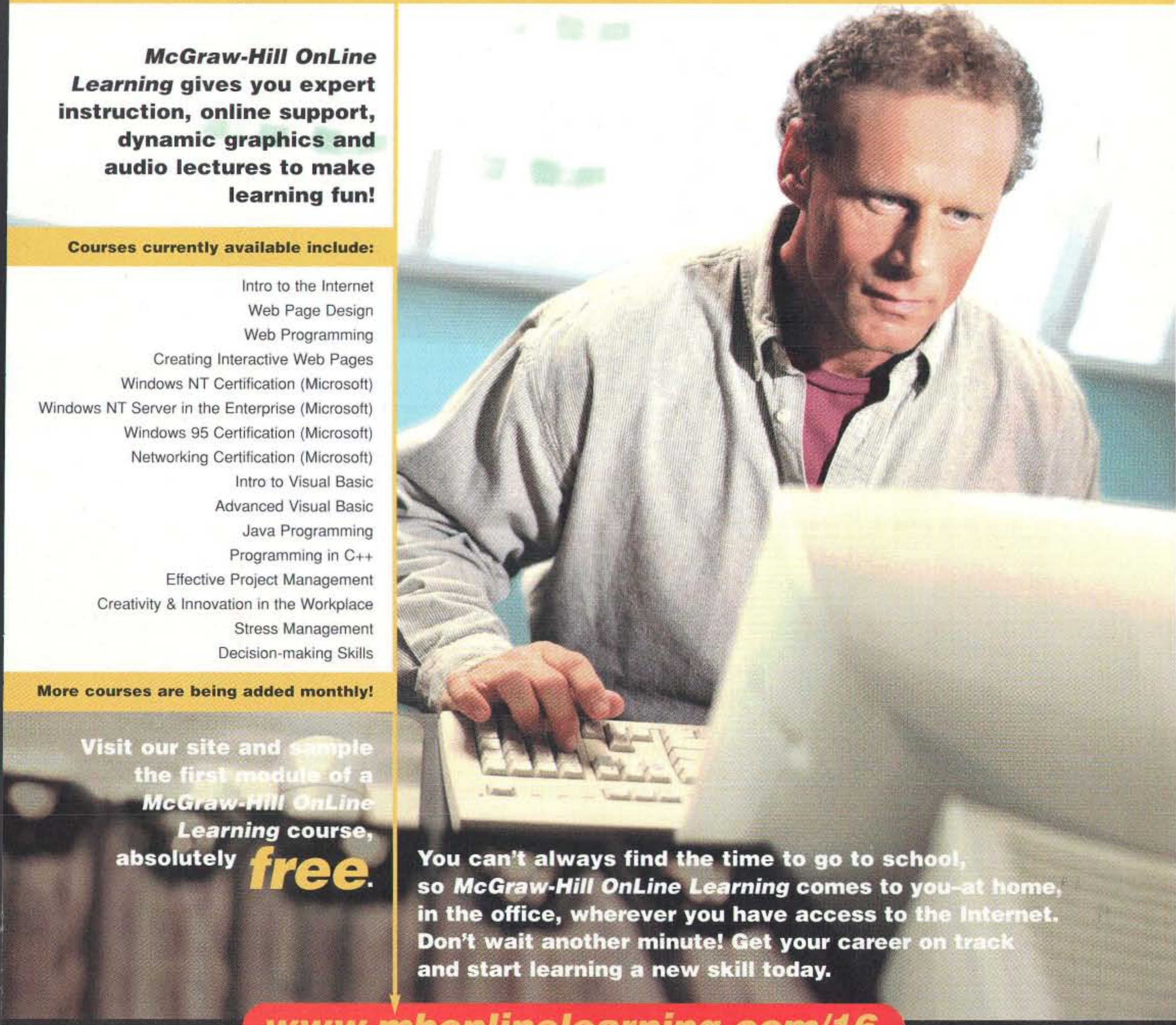

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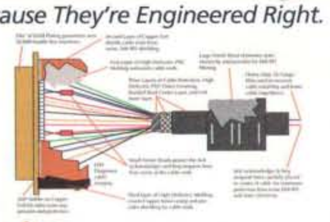

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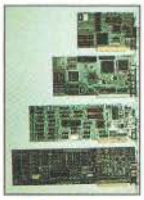

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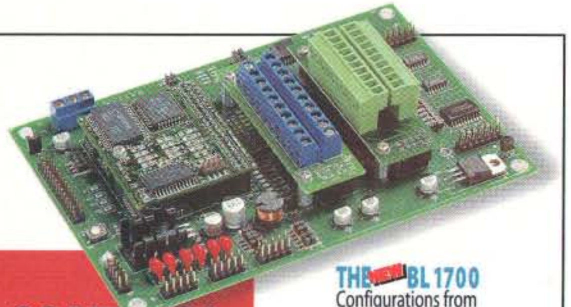

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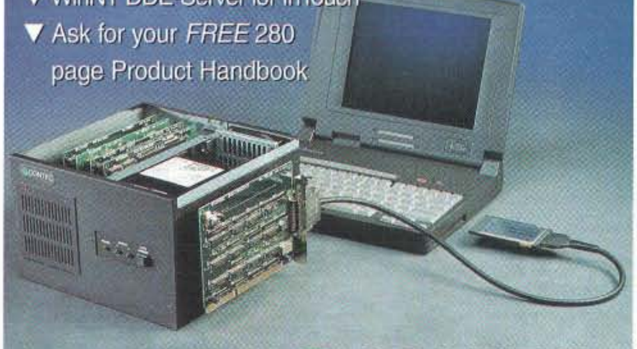

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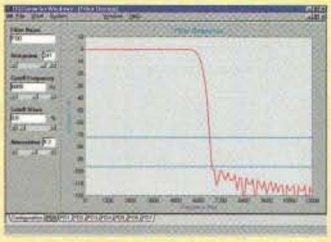

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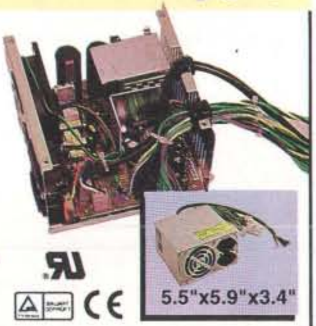

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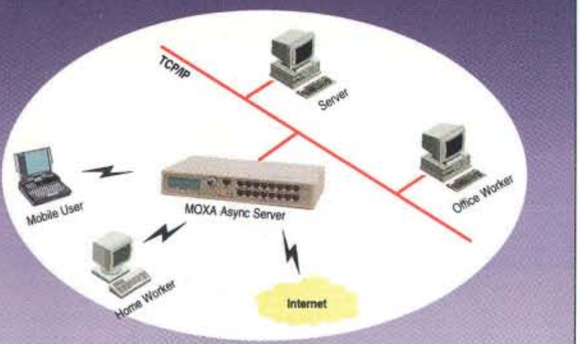

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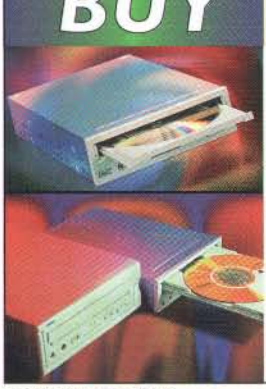

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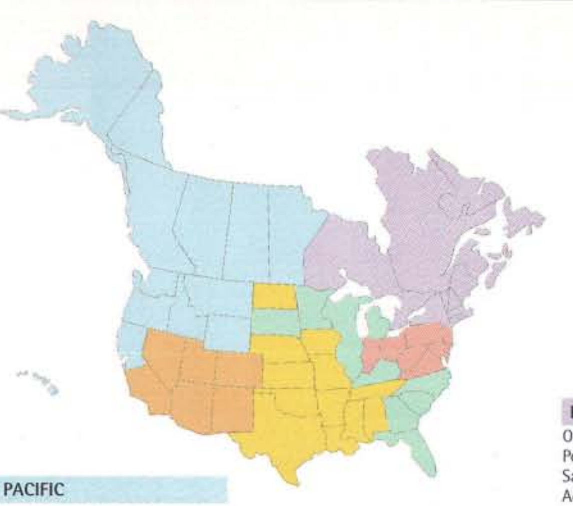

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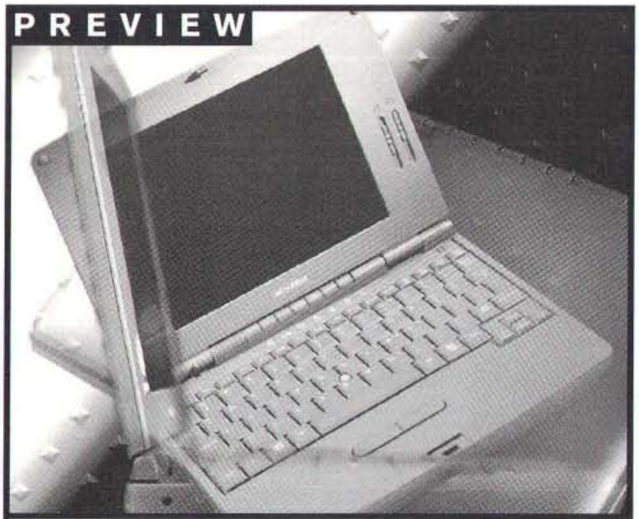
What's New

Hardware

This month, we check out Mitsubishi's new mini-notebook, Pentium II workstations, translation software, updated Linux software, and remote-access software.

PREVIEW



Mitsubishi Amity CN
$1995

Enter HotBYTEs No. 976.

Mitsubishi Electronics America
Cypress, CA
888-445-5250
714-220-2500
http://www.mitsubishi.com

Little Problems Trip Up a Little Notebook

Since last year's announcement of the Toshiba Libretto subnotebook, vendors including Hitachi, Nimantics, and Mitsubishi have raced to provide higher-powered micro-laptops. Powered by a 133-MHz Pentium processor, the $1995 Mitsubishi Amity CN fits between the 120-MHz Pentium MMX Libretto 70CT and Nimantics' 150-MHz Pentium MMX Persona T-150.

The Amity CN can accommodate from 16 to 48 MB of system RAM and a 1.2-GB hard drive. Weighing a little over 2½ pounds, the unit measures 9.3 inches wide by 6.7 inches deep by 1.34 inches tall. Its keyboard is well sized; each key is spaced 16 millimeters apart, making touch-typing bearable.

The system is not perfect, however. Take its pointing stick, which sits flush against the keyboard and is difficult to maneuver without hitting the keys next to it. I had to connect a standard PC/2 mouse to continue using the system, not a good situation for working on the road. I also found the 7.5-inch passive- matrix color display to be blotchy in areas.

I did like its external lithium-ion battery pack, which adds 7½ hours of life, weighs about 1½ pounds, and doubles as a carrying handle. It doesn't come standard, however; you'll have to shell out $383 for this feature and $300+ for a CD-ROM drive. An external floppy drive ships with the system.

This could be the perfect traveling companion, but problems with the pointing stick and screen are minuses for road warriors.

–Michelle Campanale

PHOTOGRAPH: STEVEN GREENBERG © 1998

Laptops

The Joy of Portable Computing

COMPAQ'S PRESARIO 1680 HAS ALL THE features of a high-end laptop with new enhancements to make portable computing more pleasant. A modification called 8-hour DisqPlay plays audio CDs without starting the whole system, and with its built-in bass boost, the $4199 system doubles as a potent CD Walkman or boom box, if need be. Synaptics' enhanced touchpad lets you move on-screen windows with only a finger tap on the touchpad, no buttons are needed, and has an adjustable touch threshold. The Presario 1680 has a 200-MHz Pentium MMX (upgradable to 233 MHz), a 20× CD-ROM drive, 128-bit graphics with 2 MB of video memory, a 56-Kbps modem, a USB port, and up to 96 MB of SDRAM. This gives the system power to go with its new usability features.

Contact: Compaq Computer, Houston, TX, 800-345-1518 or 713-370-0670; http://www.compaq.com.
Enter HotBYTEs No. 977.

Hand-Held PCs

Movin' on Up to Windows CE 2.0

THE VELO 500, PHILIPS' LATEST WINDOWS CE machine, is unchanged in form factor, keyboard, and all outward physical characteristics from the Velo 1. Internally, the device now supports Windows CE 2.0, and the on-board 19.2-Kbps modem has been upgraded to 28.8 Kbps. The CPU now runs at 75 MHz. The Velo 500 accepts a miniature add-in module for expanding RAM and sports a 240- by 640-pixel, 4-bit gray-scale screen. It has no PC Card slot but has expansion capabilities for RAM and ROM. It also has a V-module slot for wireless modems or a VGA monitor. It will cost $699 in 8-MB configurations and $839 with 16 MB.

Contact: Philips Mobile Computing Group, Sunnyvale, CA, 888-367-8356 or 408-523-2800; http://www.philips.com.
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Printers

Bringing Yet More to the Table

THE LATEST LEXMARK OPTRA MONOCHROME laser printers, the Optra S 1620, a 16-ppm printer, and the 24-ppm Optra S 2420, bring new networking, paper-handling, and print capabilities to the printer family's

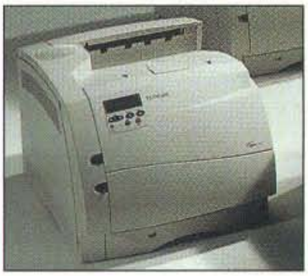

table. Both printers are rated at 1200 by 1200 true dpi. Options include 200-, 250-, and 2000-sheet drawers for paper handling. As an option, you can get 10/100Base-TX Ethernet adapters. The printers include PostScript and PCL 6 emulation for compatibility with most software. The Optra S 2420 has a street price of $1899, and the 1620 S one of $999.
Contact: Lexmark International, Lexington, KY, 800-539-6275 or 606-232-2000; http://www.lexmark.com.
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Brainy and Brawny

HEAVY-DUTY INDUSTRIAL PRINTERS DO NOT need to be big, dumb brutes that only a mechanic can diagnose and repair. Printronix's 900-line-per-minute ProLine P5209 ($7995) line-matrix printer with the company's PrintNet network interface card has its own IP address and Web page. Thus, with the correct password and Web address, you can check on a printer's status and remotely check for mechanical failures.
Contact: Printronix, Irvine, CA, 714-863-1900; http://www.printronix.com.
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Year 2000

Hardware Solution for Software Problems

THE MICRO 2000 CENTURION ($60) IS A half-height, 8-bit ISA- or EISA-slot add-in card that you install in your 286, 386, 486, or Pentium system to repair year 2000 incompatibilities. It has an on-board battery and clock, which Micro 2000 claims are good for 30 years of protection. The Centurion works with IBM-compatible motherboards. As a hardware solution, it is resistant to bugs and viruses caused by software installation.
Contact: Micro 2000, Glendale, CA, 800-864-8008 or 818-547-0125; http://www.micro2000.com.
Enter HotBYTEs No. 986.

Servers

Eight-Way NT Server

AXIL'S RACK-MOUNTABLE EIGHT-PROCESSOR Windows NT system, the NX803 ($18,000), supports up to eight 200-MHz Pentium Pro CPUs, up to 8 GB of SDRAM, and 16 PCI slots.
Contact: Axil Computer, Concord, MA, 978-371-8100; sales@axil.com; http://www.axil.com.
Enter HotBYTEs No. 979.

Rough-and-Tough Servers

THE RUFFIAN/HA ($28,995) IS NOT ONLY among the fastest Windows NT servers on the market but, the manufacturer claims, has no single point of failure. It supports the Alpha 21164 microprocessor at 600 MHz and provides redundancy and automatic switch-over capabilities with OctopusHA+ mirroring software from the Qualix Group. Configured in two side-by-side tower or rack-mounted chassis, each unit comes with two motherboards with six PCI slots, six DIMM sockets, and 2 MB of fast synchronous cache memory; dual power supplies; six 4-GB Ultra Wide disk drives with hot-swappable containers; dual RAID controllers; and dual 10/100 Ethernet controllers.
Contact: DeskStation Technology, Lenexa, KS; 913-599-1900, http://www.deskstation.com.
Enter HotBYTEs No. 1080.

CD-ROM Drives

Speed Limit: 32×

PIONEER NEW MEDIA TECHNOLOGIES clocks its Pure CAV 32× CD-ROM drive at 7300 rpm, with speeds of up to 4800 KBps. The Pure CAV 5¼-inch half-height unit has a random seek time of 60 ms and a random access time of 70 ms. A 32× CD-ROM drive can improve speed performance for data-intensive applications, loading applications and improving the performance of multimedia applications.
Contact: Pioneer New Media Technologies, Long Beach, CA, 800-444-6784 or 310-952-2111; http://www.pioneerusa.com.
Enter HotBYTEs No. 1022.

Projectors

Project Yourself Out of the Office

POLYCOM'S NEW SHOWSTATION IP ($12,999) projector extends the capabilities of an overhead projector to include remote participants with remote collaboration faculties. An XGA-resolution color camera sends color images to a remote site, and meeting participants can use the unit's electronic pen to write, draw, or erase on the projector's display, just as you would with an overhead transparency. The unit can read Microsoft Office 97 files, letting you load and store presentations from the ShowStation IP's floppy drive. The unit can host up to 10 sites without requiring an additional bridging service and supports group videoconferencing systems such as Polycom's ViewStation, which is a videoconferencing system that includes a Web server for remote presentations and diagnostics, setup, and configuration. A voice-tracking camera tracks to the person speaking. The ViewStation ($5999) supports auto-ISDN setup and provides 30-fps video.
Contact: Polycom, San Jose, CA, 800-765-9266 or 408-526-9000; ssaxon@viavideo.com; http://www.polycom.com.
Enter HotBYTEs No. 984.

Systems

A Workhorse of a Workstation

THE MEDALLION 300X-D WORKSTATION targets high-end graphics and data-intensive applications with support for the newest system technologies, which should stave off the early onset of obsolescence. It is ready for Windows 98 and NT 5.0. The system board has support for DVD and USB. The system comes with 64 MB to 1 GB of DRAM. Configurations include features such as dual 300-MHz Pentium II processors, dual-channel SCSI, AGP support, a RAID port, and an STB Velocity 128 AGP 3-D accelerator with 4 MB of SGRAM. Pricing starts at $3495.
Contact: Tangent Computer, Burlingame, CA, 650-342-9388; http://www.tangent.com.
Enter HotBYTEs No. 983.

Scanners

Scanning Without Interference

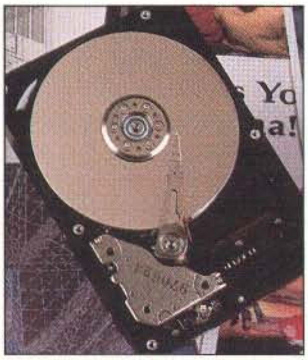
MICROTEK'S SCANMAKER 5 ($3000) IS a 36-bit 1000 by 1200 optical dpi (8000-dpi interpolated) color flatbed scanner with a built-in medium tray that eliminates distortion

when scanning slides, film, or transparencies. The medium is scanned inside the scanner, with no glass between an image and the scanner lens. Built for design professionals, it comes with ScanWizard TWAIN scanner controller software, DCR color calibration, and medium trays for 35-mm, 2¼-inch, or 4- by 6-inch film; slides; or 8- by 10-inch transparencies.
Contact: MicroTek, Redondo Beach, CA, 800-654-4160 or 310-297-5000;
http://www.microtekusa.com.
Enter HotBYTEs No. 985.

Hard Drives

Get More from Your Hard Drive

IBM HARNESSED THE CAPACITY OF ITS denser Giant Magnetoresistive



head technology to build the Deskstar 16GP, a 16.8-GB drive that's built for the desktop. The hard drive, which costs $849, makes multimedia and entertainment applications more feasible for PCs. IBM estimates that this drive, which has an areal density of 2.687 billion bits per square inch, is sufficient for users to download and store 8 hours of MPEG-2 full-motion video.
Contact: IBM Storage Systems Division, San Jose, CA, 800-426-7777;
http://www.ibm.com/storage.

Networking

Build a Smarter Network

GADZOOX'S DENALI FIBRE CHANNEL Loop (FCL) area switch, which is priced at $12,250, works with FCL hubs to build enterprise Storage Area Networks (SANs). A SAN consists of

intelligent storage devices that are connected on their own distributed network, and Denali provides three gigabit-speed Fibre Channel Loops that give you increased bandwidth and network performance.
Contact: Gadzoox Microsystems, San Jose, CA, 888-423-3222 or 408-360-4950;
http://www.gadzoox.com.
Enter HotBYTEs No. 989.

Back Up Your Backup System

THE ARK SYSTEM ($8995) PROVIDES speedy disaster recovery and high availability of data on distributed, multivendor systems. It resides between your server and backup systems, including RAID subsystems, creating multiple copies of data to be maintained on storage arrays anywhere on a WAN or LAN. The unit routes data between servers and any SCSI devices accessible on the network and supports Fast Ethernet and T1 lines.
Contact: Ark Research, San Jose, CA, 408-260-5900;
info@arkres.com;
http://www.arkres.com.
Enter HotBYTEs No. 988.

SOFTWARE

Web Development

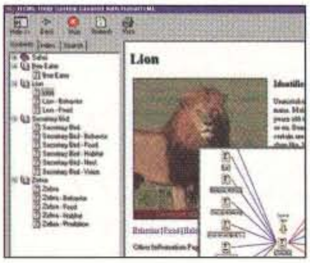
Integrated Web-Site Management

WINDDANCE NETWORKS' HTML- AND Java-based WebChallenger delivers Web-site exploration, server-failure or slow-performance alarms, content verification, server load balancing, performance measurements, real-time server-failure detection, and real-time client-usage reports. WebChallenger runs on Windows NT 4.0 and supports Web servers running on other OSes. The standard version ($1800 per server) suits single-server setups; the distributed version ($2200), multiple Web servers.
Contact: WindDance Networks, Ottawa, Ontario, Canada, 613-728-1700;
alberts@winddancenet.com;
http://www.WindDanceNet.com.
Enter HotBYTEs No. 991.

Programming

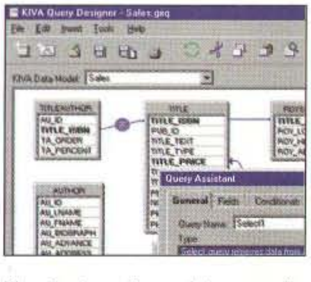
Help for HTML

BLUE SKY SOFTWARE'S ROBOHTML 1.0 ($499) is an HTML help authoring tool that complements Blue Sky's RoboHelp 5.0 and Microsoft's HTML help format. This tool automates the process of working with HTML help extensions and provides support for HTML extensions and ActiveX controls that a general-purpose HTML editor might not have.
Contact: Blue Sky Software, La Jolla, CA, 800-459-2356 or 619-459-6365;
http://www.blue-sky.com.
Enter HotBYTEs No. 992.



Web and Database Integration

KIVA'S ENTERPRISE SERVER 2.0 ($35,000 on Unix, $25,000 for Windows NT) middleware resides between Web-server software and an enterprise database, helping developers create applications that work with existing enterprise systems. Developers can use Kiva's Java and C++



KIVA Data Model: Sales

Query Name: Select1

Type

libraries to write applets or applications that talk back to the server via IIOP (using a third-party ORB from Iona or Visigenics) or Kiva's own communications protocol. The classes are transport-independent. Thus, developers can use a third-party bridge to DCOM.
Contact: Kiva Software, Mountain View, CA, 650-526-3900;
http://www.kivasoft.com.
Enter HotBYTEs No. 993.

Firewalls

Your Own Private Firewall

PC SECURE IS A PERSONAL FIREWALL THAT protects individual PC users, workgroups, or small business networks from on-line attacks. Priced at $59.99 for individual users (multiuser licenses are available), PC Secure monitors e-mail, Web activity, FTP, and any TCP/IP links you make. It alerts you when unauthorized and unwanted applets, ActiveX controls, or outside hackers invade your system or network.
Contact: Software Builders International, Atlanta, GA, 800-432-0025 or 770-541-1500;
http://www.softwarebuilders.com.
Enter HotBYTEs No. 994.

continued

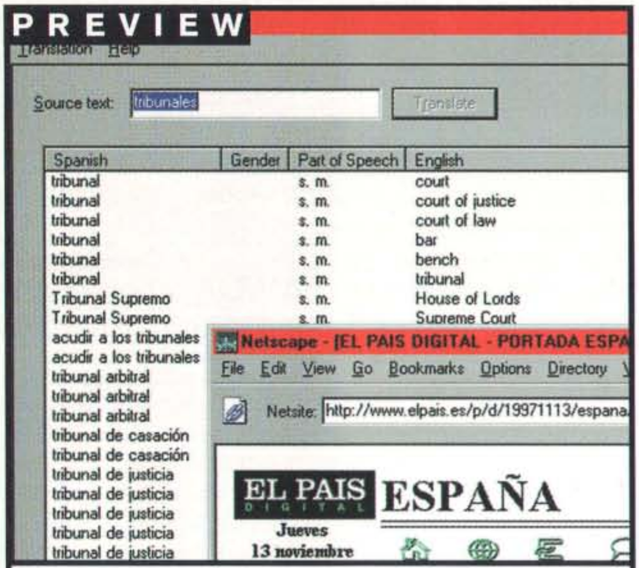
Business

An Insider's Outsourcing Tool

AS COMPANIES INCREASINGLY DEPEND ON outsourcing to get work done, a product such as Glovia 4.0 can help you keep track of outsourced labor and integrate it into existing financial, manufacturing, and customer-service operations. Priced at $2500 to $5000 per concurrent user, Glovia runs on Unix or Windows NT platforms and provides tools for managing engineering, education, and consulting jobs, tracking all associated activities and scheduling billing, progress reports, and deliveries.

Contact: Glovia International, Los Angeles, CA, 310-306-4000; http://www.glovia.com.
Enter HotBYTEs No. 995.

PREVIEW


Translation Help
Translate
Netscape - [EL PAIS DIGITAL - PORTADA ESPA
File Edit View Go Bookmarks Options Directory
EL PAIS
DIGITAL
ESPAÑA
Jueves
13 noviembre

Source text: tribunales

Spanish	Gender	Part of Speech	English
tribunal		s. m.	court
tribunal		s. m.	court of justice
tribunal		s. m.	court of law
tribunal		s. m.	bar
tribunal		s. m.	bench
tribunal		s. m.	tribunal
Tribunal Supremo		s. m.	House of Lords
Tribunal Supremo		s. m.	Supreme Court
acudir a los tribunales			
acudir a los tribunales			
tribunal arbitral			
tribunal arbitral			
tribunal arbitral			
tribunal de casación			
tribunal de casación			
tribunal de justicia			
tribunal de justicia			
tribunal de justicia			
tribunal de justicia			
tribunal de justicia			

Netsite: http://www.elpais.es/p/d/19971113/espana

WordPoint
$29.99

Enter HotBYTEs No. 1021.

Accent Software
Colorado Springs, CO
719-579-3403
info@accentsoft.com
http://www.accentsoft.com

Real-Time Translation, Word by Word

If you work for a global company or browse many Web sites with an international focus, Accent Software's WordPoint can help you understand words written in another language. WordPoint is an interactive translation utility that works with a variety of Windows applications. It performs translations automatically, without requiring you to cut, paste, or copy. Just point your cursor at the word in question, and WordPoint provides a list of likely equivalents in multiple languages. You can use WordPoint to translate between English and Hebrew, Dutch, French, German, Italian, and Spanish.

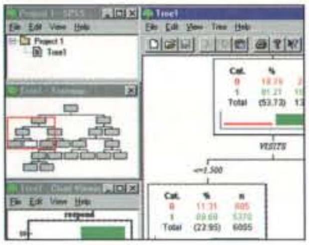
WordPoint is useful, but it won't solve all your problems. Unlike other programs available from Accent, as well as competitors such as Transparent Language, WordPoint won't translate an entire sentence or paragraph at a time. It is strictly for use on a word-by-word basis. Also, it may give you several translations for any given word, leaving you to guess which one is the relevant choice. This guess is sometimes made harder, because the program translates any verb, no matter what tense, only into the present infinitive (e.g., tracked or tracking is translated as to track).

I think WordPoint is most helpful if your job requires that you view an occasional spreadsheet or document from an international office, or for situations in which you understand most of a document in another language but get stuck on a certain word. At just $29.99, WordPoint is a useful utility, but you'll need to look elsewhere for more comprehensive language-translation software.

–Elena Arroyo

Making Sense of Your Data

ANSWERTREE ($495) IS AN ODBC-COMpliant data-mining tool that builds profiles, predicts outcomes and trends, and uncovers patterns in data. It presents data in simple tree diagrams and color-coded charts and tables. It contains eight decision-tree methods for applications such as market research, direct mail, credit scoring, quality control, and institutional research.

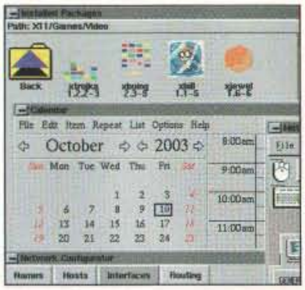


Contact: SPSS, Chicago, IL, 800-543-2185 or 312-329-2400; http://www.spss.com.
Enter HotBYTEs No. 996.

Operating Systems

Linux for the People

LINUX IS CONSIDERED BY SOME TO BE UNIX-for-geeks-with-PCs, but Red Hat Linux 5.0 ($49.95) aims to make the popular OS accessible to the mass market. This multitasking OS runs on Intel, Digital Alpha, and Sun SPARC systems; provides simplified installation through a new disk-partitioning user interface; and offers automatic hardware probing and configuration, sound support, and an interface for system administrators. This latest release includes a new C library called Glibc that offers better internationalization and support for threads. Red Hat Linux 5.0 includes configuration for multiple managers, graphical user-level tools, Internet audio broadcaster Real Audio, backup utility BRU, and an X server.



Contact: Red Hat Software, Research Triangle Park, NC, 888-733-4281 or 919-547-0012; http://www.redhat.com.
Enter HotBYTEs No. 998.

Telephony

A Universal Inbox

COMMUNICATE PRO ($179) HAS A SINGLE graphical interface for collecting and coordinating all your messaging services, including voice mail, pager, fax, e-mail, contact management, and Internet phone capabilities. It can automatically file voice, e-mail, and fax messages by name into the contact manager, and has auto-attendant voice-mail features, including the ability to give private messages to preselected incoming phone calls. It has a simple POP3 e-mail client and fax-on-demand. It supports text attachments to outgoing pager messages.

Contact: 01 Communique Laboratory, Mississauga, Ontario, Canada, 905-795-2888; http://www.01com.com.
Enter HotBYTEs No. 1002.

Dictation

Speak Naturally to Microsoft Word

DRAGON HAS EXPANDED ITS FAMILY OF continuous speech programs for

Windows. With NaturallySpeaking Preferred Edition ($229), you can dictate directly into Microsoft Word. The program also lets multiple people create their own voice files and use them on the same system, for better accuracy in a multiuser setup. It can record your speech for proofreading and editing. It also has a text-to-speech and mouse-grid voice controller for better control over the mouse cursor. The Deluxe version ($695) has all the above capabilities, plus a macro language, multiple topic support, integration with hands-free control software DragonDictate 3.0 Classic (included), an active vocabulary of 55,000 words, and a noise-canceling headset. You'll need at least a 133-MHz Pentium processor.

Contact: Dragon Systems, Newton, MA, 800-825-5893 or 617-965-5200; http://www.naturalspeech.com.

Enter HotBYTEs No. 1003.

Software Update

EUDORA PRO 4.0 ($39) KEEPS ABREAST OF THE LATEST E-MAIL, INTERNET, AND directory protocols, and provides an updated interface and an enhanced client called Eudora Pro CommCenter ($59). Eudora Pro 4.0 now supports IMAP4, for accessing files from remote locations; LDAP, which supports directory services; and MIME/HTML, to compose HTML documents with tables, embedded sounds, images, and applets. The user interface has a movable icon-based menu bar, and a file browser simplifies importing files with a new drag-and-drop interface. Eudora Pro CommCenter 4.0 is ad hoc groupware, with shared folders and document synchronization. It has a universal inbox for e-mail, voice, and fax communications; Internet paging; synchronization with the PalmPilot Address Book; and news and content delivery. You can run the application with voice control based on IBM's ViaVoice speech-recognition technology.

Contact: Qualcomm, San Diego, CA, 619-587-1121; http://www.qualcomm.com.

Enter HotBYTEs No. 1004.

CORELDRAW 8 GRAPHICS AND IMAGE-EDITING SOFTWARE FOR WINDOWS HAS been upgraded to support more file formats while offering a customizable interface. Users can now simultaneously import multiple files and specify their placement on a page at any location in a CorelDraw document. In addition, there are now options to import an image at original size, scale the image proportionally, or scale without maintaining aspect ratio at import time. Personal preferences and custom toolbars can be saved for multiple users, and the program can handle animated GIFs, JPEG preview capabilities, HTML tables, cascading style sheets, and Netscape layers. It costs $695 for the full version and $249 for the upgraded version.

Contact: Corel, Ottawa, Ontario, Canada, 613-728-3733; http://www.corel.com.

Enter HotBYTEs No. 1005.

COSESSION REMOTE 32 VERSION 8 IS A 32-BIT IMPLEMENTATION OF ARTIsoft's remote-access software for remotely running applications and document sharing. It now offers control over individual or group rights to data, as well as password protection, encryption, and keyboard and mouse locking for better security. It is now possible to converse over modem, network connection, or the Internet while conducting remote-control sessions and file transfers. It starts at $119 for a two-PC version; supports connections between Windows 95 and Windows NT 4.0 over modem, network, or the Internet; and supports Novell NetWare, IPX/SPX, NetBIOS, and Artisoft's LANtastic.

Contact: Artisoft, Iselin, NJ, 800-846-9726 or 908-855-9440; http://www.artisoft.com.

Enter HotBYTEs No. 1006.

Remote Access

Remote Access for Administrators

NETOP FOR WINDOWS ($149), FROM CrossTec, is remote-access software that can reach multiple PCs on multiple platforms simultaneously. You can remotely control PCs with dial-in or Internet access on Windows 3.x, NT, and 95; DOS; or OS/2. It can handle and route traffic via TCP/IP, NetBIOS, and IPX, automatically translating whichever protocol a situation demands. NetOp for Windows is designed for help-desk support, remote software loading, or remote configuration.

Contact: CrossTec, Boca Raton, FL, 800-675-0729 or 561-391-6560; http://www.4ctc.com.

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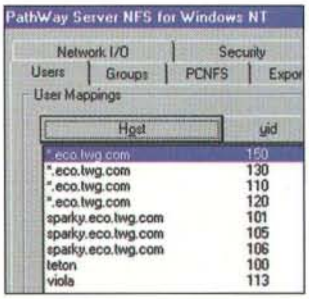

User Mappings

Host	uid
*.eco.twg.com	150
*.eco.twg.com	130
*.eco.twg.com	110
*.eco.twg.com	120
sparky.eco.twg.com	101
sparky.eco.twg.com	105
sparky.eco.twg.com	106
teton	100
viola	113

Videoconferencing

More Scalable Videoconferencing

WHILE VIDEOCONFERENCING BREAKS BARriers between people, BoxTop Interactive's iVisit aims to break barriers in videoconferencing technology. The product is scalable because it doesn't need a reflector like other videoconferencing tools. BoxTop simply maintains a directory server that keeps a list of names and IP addresses of iVisit users. You contact someone by querying this server. A black-and-white version is available for free downloading at http://www.boxtop.com, a color consumer version costs $49, and there is also a corporate version with a proxy server for operating within a firewall.

Contact: BoxTop Interactive, Los Angeles, CA, 310-235-3900; http://www.boxtop.com.

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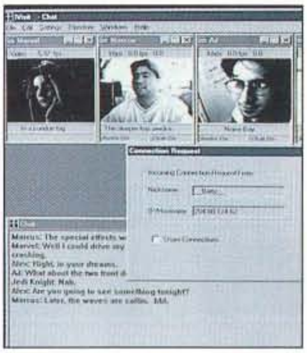

Cross-Platform

Standards-Based Interoperability

NFS IS A UNIX FILE SYSTEM THAT, AMONG other things, allows NT applications to run on Unix platforms. Attachmate's PathWay Server NFS for Windows NT uses this open standard to provide any NFS client with access to heterogeneous file and print services located on Unix, NT, VMS, Hewlett-Packard, or IBM mainframe environments. The PathWay NFS Server costs $395, runs on Intel or Alpha platforms, and includes WebNFS for firewall and TCP support.

Contact: Attachmate, Bellevue, WA, 425-644-4010; http://www.attachmate.com/osg.

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improbable

Readers ranging from angry professionals to country programmers write us.

Advances and Retreats in Computing

MaiL CaLL

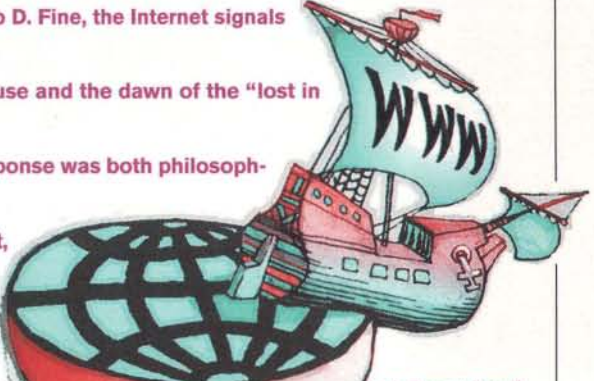
Letter End Zone Last June, we mentioned this snippet of an Associated Press news item: "An editorial in the Iraqi government newspaper *Al-Jumhuriya* says that the Internet...is 'the end of civilizations, cultures, interests, and ethics.' " What else, we asked, is the Internet the end of? Some responses we received were philosophical: "It is the end of that age that was ruled by isolation and dogmatic doctrines, and the beginning of a new age that will be ruled by communication, reason, and the common good," predicted P. DeMoss.

Many other readers' responses about what the Internet has doomed were more pragmatic: "Poor stock performance for modem companies," wrote D. Johnson. "Stamps," replied R. Browning. And, according to D. Fine, the Internet signals the end of the "lost in the mail" excuse and the dawn of the "lost in the server" excuse. G. S. Haber's response was both philosophical and pragmatic: "Sleep, breakfast, quality time with my peacock Elwood." V. S. Smith's was both philosophical and poetic: "The Internet is also the end of boring rainy-day lunch hours; of quickly looking something up in an encyclopedia; of needing friends, a life, any form of social contact; of watching mindless TV late into the night...."

Many readers' predictions were bibliocentric. Quite a few trumpeted the Internet as "the end of research in libraries."

Readers differed in their opinions on the Internet's effect on cognitive science. The cryptically named EStew62170 predicted "The end of ignorance–the beginning of understanding." But S. Vance took the opposite view: "Intelligence–have you read some of the 'conversations' on chat lines?"

We end this discussion with the words of Michael John, in whose estimation the Internet is "...the end of civilizations who claim the Internet is the end of civilizations."



Fighting Words Our report about Ebonics and the C++ dialect brought a deluge of mail. Most of it was from native C++ speakers. Some urged us to interpret their thoughts for the general public; others wanted their words compiled and stored for later use.

A few letters came from people who were outraged at the reference to Ebonics. Nearly all the 10 angry correspondents used the word *professional* in describing themselves. Anticipating them, Mary Benton, a self-described "country programmer from Missouri" wrote: "I'll bet you get angry letters because you mentioned Ebonics. To me, the very word *Ebonics* is another example of what happens when stupid academic jargon escapes into the public. Academics, politicians, and reporters get to show us how pompous they can be. Let's not forget *paradigm*, *critical thinking*, *new math*, *excellence*, and, my all-time favorite, *quality*. I just love to hear self-inflated people spout these words." Dale Roberts sent in this report about lingo in Silicon Valley: "Must I use standard English at Safeway, where the clerks are now fluent in high-bandwidth frame-relay terminologies? The most unlikely place you'll encounter standard English might be in any bar along San Francisco's Market Street after 4:00 p.m. weekdays, when headhunters line up with cell phones and mumble incoherently about highly technical topics, with dubious results."

Marc Abrahams is the editor of the Annals of Improbable Research. *You can contact him by sending e-mail to* **marca@improb.com.**

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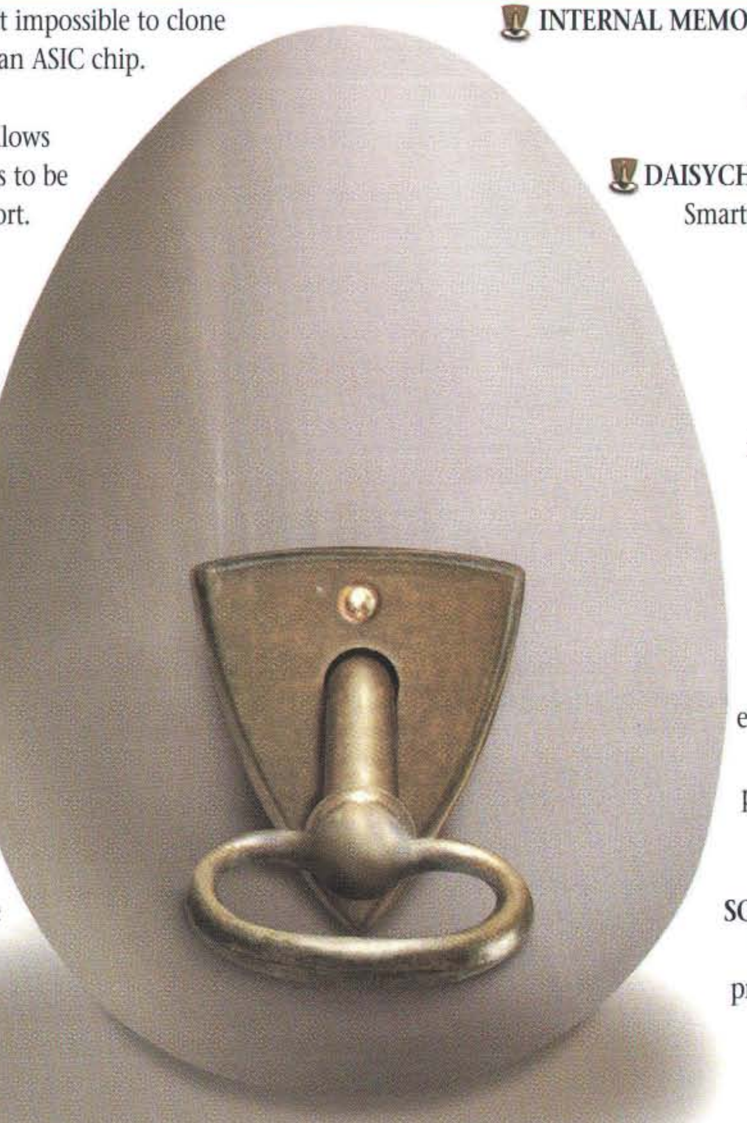
If you really care for your software protect it.

SMARTKEY THE INTELLIGENT SOFTWARE PROTECTION.



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